INSTRUCTION MANUAL

Type 200 - C

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IF YOUR INSTRUMENT DOES NOT OPERATE

PLEASE

1. Check operating procedure in manual for proper set-up.
2. Check fuse and power supply voltages.
3. Consult the brief trouble shooting guide at the beginning of the MAINTENANCE section of this manual.
4. Call your EXACT representative or the factory collect.

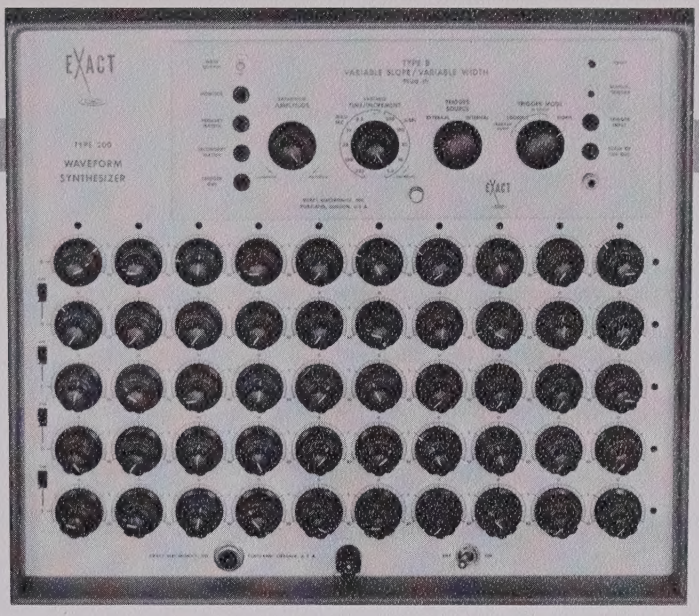
A new instrument should operate properly on arrival and no-one wishes this more than Exact. Many things keep this from happening in every case and if yours is the exception, you should be inconvenienced as little as possible. Some people like to find a trouble themselves, others prefer not to touch an instrument without representation from the manufacturer. **YOUR WARRANTY WILL IN NO WAY BE AFFECTED BY YOUR EFFORT TO FIND THE TROUBLE AND PUT YOUR INSTRUMENT IN EARLY OPERATION.** We leave it to your judgment and offer the services of our representatives and our factory to give you the assistance you need.

WARRANTY

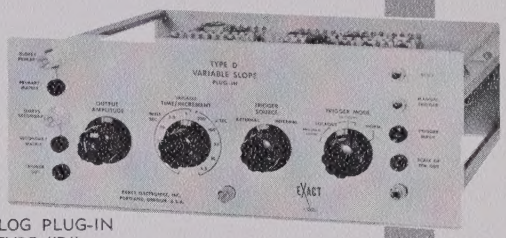
All Exact instruments are fully guaranteed against defective materials and workmanship for one year. Replacement parts requests should be clearly identified and the instrument serial number given. The needed parts will be air shipped to you within 24 hours.

EXACT Electronics, Inc

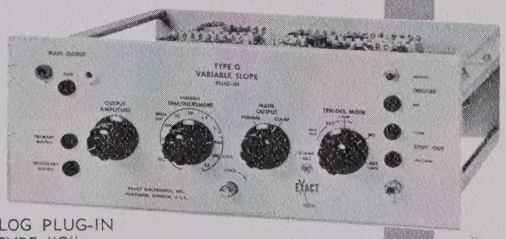
TYPE 200 COMPLEX WAVEFORM GENERATOR



200 WITH ANALOG—PLUG-IN TYPE "B"

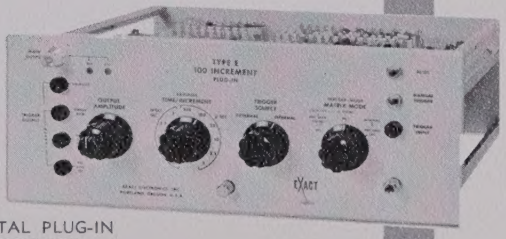


ANALOG PLUG-IN
TYPE "D"



ANALOG PLUG-IN
TYPE "G"

DIGITAL PLUG-IN
TYPE "C"



DIGITAL PLUG-IN
TYPE "E"

The **Type 200 Waveform Synthesizer** produces from 10 to 100 individual and independent BITS or incremental voltage levels. These levels may be completely controlled (programmed) in SLOPE, AMPLITUDE and WIDTH by 5 different plug-in generators. The plug-in generators provide the timing clock (commutator), the output amplifier and the trigger and synch pulse outputs. Selection of a plug-in generator determines whether the bit (increment) controls will vary slope, amplitude, width, or a combination of these variables.

This "ANY FUNCTION" Generator is completely self-contained, requiring no auxiliary equipment or accessories. The 30 to 50 volt digital or analog output waveforms may be — continuously generated — externally triggered — manually triggered or controlled by an external timing device.

ABOUT EXACT'S 200 WAVEFORM SYNTHESIZER

GENERAL:

The Type 200 Complex Waveform Generator (Waveform Synthesizer) contains fifty dual-controls. Each control allows adjustment of two parameters per increment. The controls are arranged in five rows of 10 each. The rows may be selected to produce an output waveform consisting of 10, 20, 30, 40 or 50 increments.

By selecting one of the five available Plug-In Generators the function of the fifty dual controls can be chosen to produce:

(1) Extended programs of up to 100 increments with amplitude adjustment for each bit.

(2) A program of up to 50 increments with amplitude and individual width adjustment (up to 10 x expansion) for each.

(3) Adjustable slope and amplitude for each increment.

(4) Two simultaneous outputs with separate slope adjustments for each increment.

(5) Adjustable slope and duration for each increment.

APPLICATIONS:

The Waveform Synthesizer can produce an infinite variety of complex waveforms for almost all applications. A few proven applications follow: SHOCK-TABLE DRIVE. The Synthesizer can be used to drive vibration tables for shock testing and can be adjusted to compensate for inherent characteristics such as overshoot and ringing. The table can be forced to follow a desired function. SIMULATION OF MEDICAL INFORMATION. Nerve, muscle potentials, and heart pulses have been simulated for research. Pulses can be generated and altered to simulate abnormal conditions thus eliminating the time required to sample scores of patients to acquire "live" data. SIMULATION OF TELEMETRY DATA. Up to 100 bits of telemetry data may be produced. Amplitudes and duration of simulated data can be varied to check marginal operation of telemetry equipment. WAVEFORM ANALYSIS AND DISTORTION STUDIES. Waveforms have been generated and modified, enabling the engineer to analyze design requirements, or to evaluate the limits of existing circuits. COMPENSATION FOR DISTORTION OR NON-LINEARITY. Waveforms are useful in the design of equipment to counteract distortion or non-linearity in amplifiers, and in cases where compensating waveforms are required in operational equipment.

TRIGGERING:

The Type 200 with all plug-ins can be internally, externally or manually triggered as follows:

(1) Internal: The output waveform recycles automatically

(2) External or Manual:

a. One trigger produces one increment.

b. One trigger produces a row of ten increments sequentially.

c. One trigger produces a program of 20 to 100 increments.

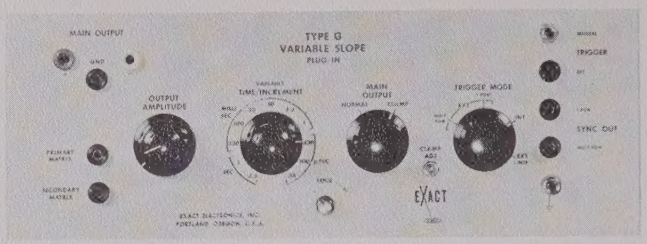
FREQUENCY AND TIMING:

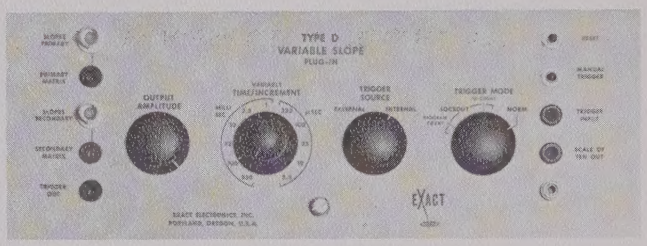
Internal timing is calibrated in steps of 3.3, 10, 33, etc. from 3.3 usec to 1 second per increment. Modifications are available to extend the lower range down to 10 seconds per increment.

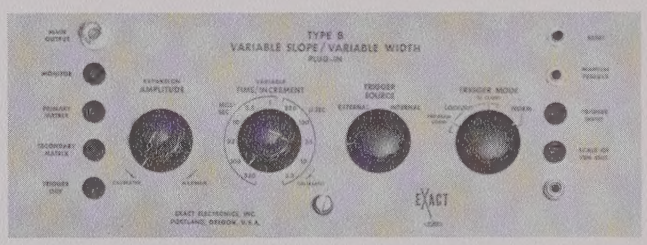
The variable width Plug-In Generators allow expansion down to 100 seconds per increment.

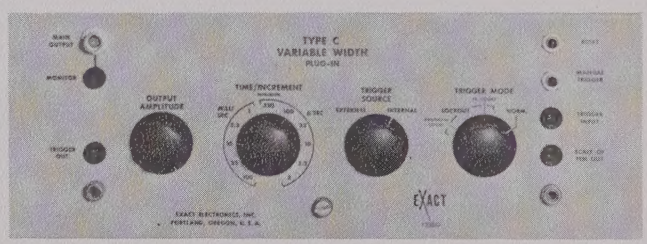
WARRANTY

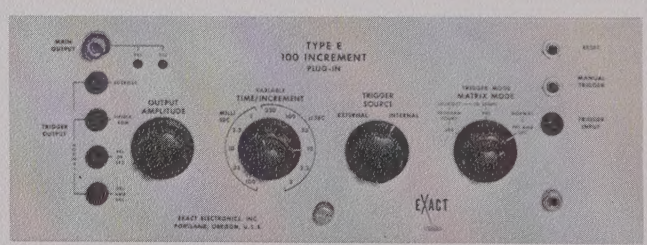
All Exact Function Generators are fully warranted against defective materials or workmanship for one year. Responsible maintenance and repair centers are located in major cities throughout the world.

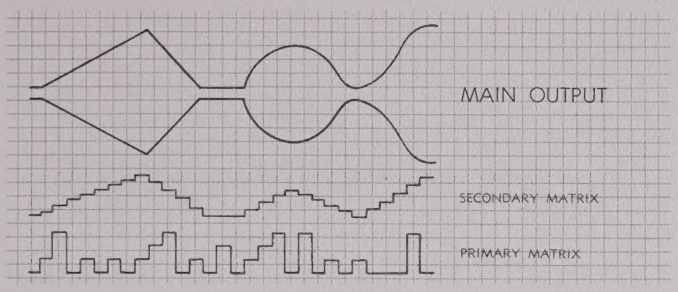


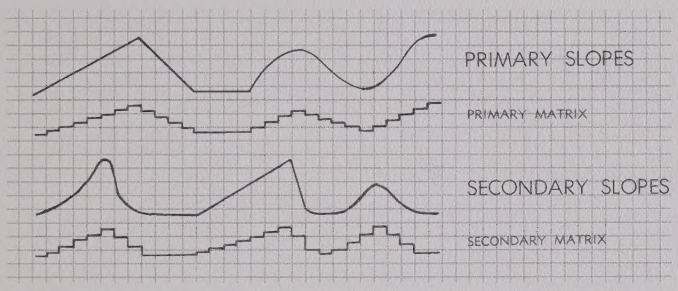


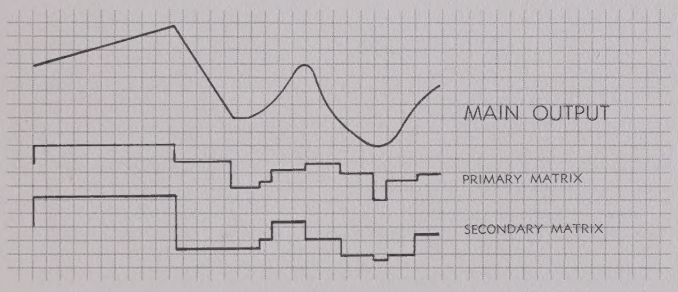












The B, D and G Plug-In Generators are similar in that they all produce analog waveforms composed of 50 individual and independent slope segments as a main output. Primary and secondary matrix outputs are hi impedance, low voltage digital levels from the bit (incremental) controls.

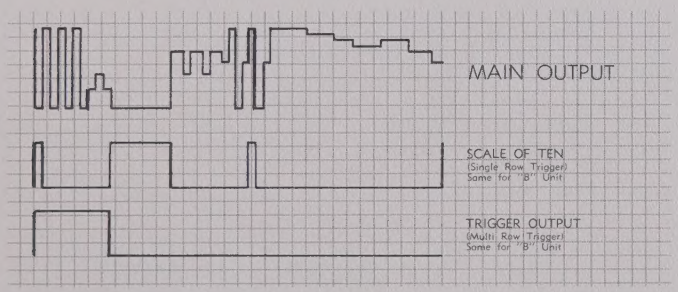
Trigger and scale of ten pulses are derived from the first row gate and the first bit (increment) of each row respectively, and are available from front panel terminals.

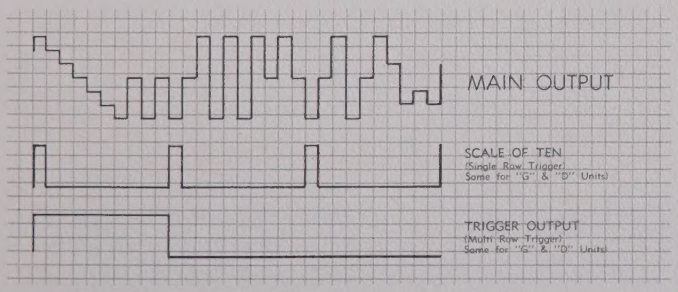
The G Plug-In is the "workhorse" and produces a push-pull or mirror image complex waveform of 50 volt maximum) amplitude. A separate CLAMP adjustment allows the DC level of the first increment to be set independent of slope adjustment so that the waveform will not shift while being adjusted and will always start at that level regardless of trigger source. Since only one matrix (secondary) is used to program the slopes, the auxiliary digital or bit output of the other matrix (primary) may be used as an independent "extra" programmer.

ANALOG

The D Plug-In is essentially the same as the G but without clamp adjustment. Each matrix programs a separate slope generator so that two simultaneous and independent complex waveforms are produced. Minor inherent interaction between matrices requires greater operator skill than with the G unit.

The B Plug-In basically combines the slope generation of the G with the variable width per increment capability of the C plug-in discussed below. The resulting output waveform is a product of 50 increments independently variable in slope and width. It is an excellent solution to the problem of generating a waveform with both long and short term variations. Considerable operator skill is necessary to avoid long set up time.





The C and E Plug-In Generators are similar in that they both produce digital waveforms composed of 50 or 100 independent DC levels as main outputs. As in the analog generators, trigger and scale of ten pulses are derived from the first row gate and the first row bit (increment) of each row respectively and are available from front panel terminals.

The E Plug-In produces programs with 20 to 100 incremental DC levels. Each dual control adjusts the amplitude incremental DC level during two increments (1 and 51, 6 and 56, 24 and 74, etc.). Increment width is variable from 2 usec to 1 sec, with all increments being the same width.

DIGITAL

The C Plug-In is the most popular of the digital generators and produces a program of 10 to 50 incremental DC levels. Each dual control adjusts the amplitude (increment DC level) and the width of each increment.

The duration of the program is the sum of the width of the component increments. Each increment is variable from 2 usec to 330 milsec with the main timing controls. In addition, individual increment expansion control (secondary matrix control) increases the width of each increment independently up to 10 times.

SPECIFICATIONS

Type 200 and Plug-Ins

PARAMETER	G	D	B	C	E
MAIN OUTPUT Amplitude	1 to 50 VPP (var)	15 to 50 VPP (var)	5 to 50 VPP (var)	10 to 30 VPP (var)	
Amplitude Stability/Repeatability	Within 5% of max output voltage			Within 1% of max output voltage	
Center Reference Level	−10 to 10 V (var)	0 to + 25 V (var)	−10 to + 10 V	0 to 15 V (var)	−15 V to GND (var)
Output Current	5 Ma Max			10 Ma Max	
Number of Increments	10 to 50				20 to 100
Width Per Increment Calibrated	33 usec to 3.3 sec	3.3 usec to 330 ms	3.3 usec to 3.3 sec	2 usec to 100 msec	2 usec to 330 msec
Dynamic Range	33 usec to 10 sec	3.3 usec to 1 sec	3.3 usec to 10 sec		2 usec to 1 sec
Expansion	None		10 times		None
Accuracy (dial setting)	Within 0.1% between any 2 increments " 5% " " switched ranges		Within 3%	Within 5%	
Time Stability/Repeatability	Within 0.1%		Within 0.2%		Within 0.1%
Rise & Fall Time	Increment width			0.5 usec	
MATRIX OUTPUTS Amplitude	0 to 10 VPP (min)		0 to 10 VPP (min)		
Output Current	0.5 ma		0.5 ma		
Rise & Fall Time	0.5 usec		0.75 usec		
TRIGGER OUTPUTS Scale of 10 (single row)	35 VP (min) Start of each row				40 VP (min)
Trigger Out (multi row)	15 VP (min) Start of each program				40 VP (min)
TRIGGERING Internal	Automatically recycles continuously				
External/Manual	* Trigger produces 1 increment				
10 Count Lockout	1 Trigger produces 1 row of increments (10)				
Program Lockout	1 Trigger produces 1 program (20 to 100 increments)				
PHYSICAL CHARACTERISTICS Weight	Net: 6 lbs.; Gross: 10 lbs.				
Volume	0.8 cu ft. Gross				
Dimensions	12" w x 5" h x 12" d				
PRICE F.O.B. FACTORY (Plug-Ins Only)	**$400.00**	**$400.00**	**$500.00**	**$400.00**	**$400.00**

THE 200 WAVEFORM SYNTHESIZER

Power Requirements: 105-125, 210-250 VAC
50-60 cps, 375 watts

Dimensions: 17½" w x 15½" h x 14½" d

Weight: Net: 51 lbs.; Gross 64 lbs. (less plug-ins)

Price: $1925.00
(Without Plug-Ins)

*Positive-going, 10-volt minimum amplitude, 1 usec or faster risetime.

All specification and price information is subject to change without notice.

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SECTION I

DESCRIPTION AND CHARACTERISTICS

GENERAL DESCRIPTION

THE TYPE 200 WAVEFORM SYNTHESIZER IS THE BASIC UNIT OF A WAVEFORM SYNTHESIZING SYSTEM. THE TYPE 200 IS DESIGNED FOR USE WITH ANY OF SEVERAL AVAILABLE EXACT PLUG-IN UNITS (I.E. TYPE B, C, D, E, F OR G).

WITH THE TYPE 200 AND ITS ASSOCIATED PLUG-IN UNITS, YOU CAN ELECTRONICALLY COMPOSE AN INFINITE VARIETY OF COMPLEX WAVESHAPES WITHIN A WIDE FREQUENCY RANGE.

THE TYPE 200 CONSISTS OF A PRIMARY AND A SECONDARY MATRIX, HORIZONTAL AND VERTICAL STEPPING COUNTERS AND A POWER SUPPLY. THE POWER SUPPLY ALSO FURNISHES POWER FOR THE PLUG-IN UNITS.

THE FOLLOWING IS A GENERAL GUIDE SHOWING SOME OF THE BASIC CAPABILITIES OF THE TYPE 200 WITH EACH OF THE AVAILABLE PLUG-IN UNITS. FOR MORE DETAILED SPECIFICATIONS ON A GIVEN PLUG-IN UNIT, SEE THE APPROPRIATE SECTION OF THIS INSTRUCTION MANUAL.

TYPE B - - - - - PROVIDES INDEPENDENTLY VARIABLE SLOPE AND WIDTH OF EACH INCREMENT UP TO 50 INCREMENTS. COMBINES THE SLOPE GENERATION OF THE G UNIT AND THE VARIABLE WIDTH PER INCREMENT OF THE C UNIT.

TYPE C - - - - - PROVIDES ADJUSTABLE AMPLITUDE AND WIDTH OF EACH INCREMENT UP TO 50 INCREMENTS. TOTAL DURATION OF THE COMPLETE CYCLE (OR PROGRAM) IS EQUAL TO THE SUM OF THE WIDTHS OF ALL THE INCREMENTS IN USE.

TYPE D - - - - - PROVIDES TWO SIMULTANEOUS AND SEPARATE OUTPUTS. EACH OUTPUT CONSISTS OF UP TO 50 INCREMENTS WITH THE SLOPE OF EACH INCREMENT ADJUSTABLE. ADJUSTMENT OF ANY INDIVIDUAL INCREMENT AUTOMATICALLY VARIES THE AMPLITUDE OF THE START OF THE FOLLOWING INCREMENT, RESULTING IN A CONTINUOUS WAVEFORM OF VARYING SLOPES.

TYPE E - - - - - AN EXTENDED PROGRAM PLUG-IN UNIT THAT PROVIDES UP TO ONE HUNDRED INCREMENTS PER PROGRAM WITH ADJUSTABLE AMPLITUDE OF EACH INCREMENT.

TYPE F - - - - - PROVIDES ADJUSTABLE SLOPE AND AMPLITUDE OF EACH INCREMENT UP TO 50 INCREMENTS. A SLOPES ONLY OUTPUT PROVIDES CONTINUOUS SLOPES WITH THE AMPLITUDE AT THE BEGINNING OF EACH INCREMENT THE SAME AS THE AMPLITUDE AT THE END OF THE PRECEDING INCREMENT. A MIXED OUTPUT PROVIDES AN OUTPUT PROGRAM WITH COMBINED CONTROL OF SLOPE AND AMPLITUDE. VARYING THE SLOPE OF AN INCREMENT VARIES THE START OF THE NEXT INCREMENT THE SAME AMOUNT, ALTHOUGH IT MAY BE ADJUSTED TO A DIFFERENT AMPLITUDE.

TYPE G - - - - - - PRODUCES A PUSH-PULL OR MIRROR IMAGE COMPLEX WAVEFORM OF 50-VOLT (MAXIMUM) AMPLITUDE. A "CLAMP" ADJUSTMENT ALLOWS THE DC LEVEL OF THE FIRST INCREMENT TO BE SET INDEPENDENT OF SLOPE ADJUSTMENT TO KEEP THE WAVEFORM FROM SHIFTING AND TO CAUSE IT TO ALWAYS START AT THE SAME LEVEL REGARDLESS OF THE TRIGGER SOURCE. ONLY THE SECONDARY MATRIX IS USED TO PROGRAM THE SLOPES SO THAT THE AUXILIARY DIGITAL OR BIT OUTPUT OF THE PRIMARY MATRIX MAY BE USED AS AN INDEPENDENT PROGRAMMER.

GENERAL CHARACTERISTICS OF THE TYPE 200

RISETIME/FALLTIME
0.3μSEC.

POWER SUPPLIES — ELECTRONICALLY REGULATED VOLTAGES OF -210, -60, +100 AND +250 VOLTS, ±3%.

LINE POWER — 105-125 VOLTS AT 50-60 CPS, 375 WATTS.

MECHANICAL — CONSTRUCTION: ALUMINUM ALLOY CHASSIS WITH A PHOTO-ETCHED, CERAMICIZED ALUMINUM FRONT PANEL. WEIGHT (TYPE 200 WITHOUT PLUG-IN): 50 LBS NET, 64 LBS GROSS. WEIGHT (TYPE 200 WITH PLUG-IN): 57 LBS NET, 70 LBS GROSS. DIMENSIONS: 17-1/2" (W) X 15-1/2" (H) X 14" (D).

SECTION 2

OPERATING INSTRUCTIONS

GENERAL

THIS SECTION OF THE MANUAL DESCRIBES THE FRONT-PANEL CONTROLS OF THE TYPE 200. IN ADDITION, ABBREVIATED OPERATING INSTRUCTIONS ARE GIVEN FOR EACH PLUG-IN UNIT. DETAILED OPERATING INSTRUCTIONS APPEAR IN THE PLUG-IN SECTION.

FRONT PANEL CONTROLS

ON-OFF POWER SWITCH

TURNS THE UNIT OFF OR ON. A RED PANEL LAMP LIGHTS WHEN THE POWER IS ON.

PROGRAM LEVEL CONTROLS

FIFTY DUAL CONTROLS SET THE AMPLITUDE AND SHAPE OF THE OUTPUT WAVEFORM. ARRANGED IN FIVE HORIZONTAL ROWS (A, B, C, D AND E) OF TEN EACH. THE BLACK KNOBS SET THE OUTPUT OF THE PRIMARY MATRIX. THE RED KNOBS SET THE OUTPUT OF THE SECONDARY MATRIX INCREMENTS.

ROW SWITCHES — FOUR SLIDE SWITCHES PUT ROW B, C, D OR E IN OR OUT OF THE PROGRAM.

NEON INDICATORS — TEN NEON LAMPS ABOVE THE "A" ROW SHOW WHICH INCREMENT IS PRESENT AT THE OUTPUT, WHILE FIVE NEON LAMPS AT THE END OF EACH ROW SHOW THE ROW IN USE.

PROGRAMMING

1. ALWAYS START SETTING UP A PROGRAM WITH INCREMENT #1, ROW "A" (UPPER LEFT-HAND CONTROL), AND MOVE TO THE RIGHT ACROSS THE ROW. AFTER COMPLETING ROW "A", MOVE TO THE ROW BELOW AND REPEAT AS IN ROW "A". SWITCH OFF ANY ROWS THAT ARE NOT NEEDED. CONTINUE TO SET EACH CONTROL UNTIL YOU REACH THE TENTH INCREMENT IN ROW "E". THIS IS THE LAST INCREMENT OF THE PROGRAM WHEN A FULL 50-INCREMENT PROGRAM IS USED.

2. ANY ROW EXCEPT ROW "A" CAN BE SWITCHED OUT OF A PROGRAM. FOR EXAMPLE, IF THE ROW "B" SLIDE SWITCH IS SET TO OUT, THE PROGRAM WILL STEP FROM THE TENTH INCREMENT IN ROW "A" TO THE FIRST INCREMENT IN ROW "C". IF ALL THE ROW SWITCHES ARE SET TO OUT, ONLY THE PROGRAM OF ROW "A" WILL BE IN OPERATION.

NOTE

IF A ROW IS SWITCHED OUT WHILE THE INCREMENTS IN THAT ROW ARE BEING COUNTED, ONLY THE ROW THAT IS SWITCHED OUT WILL CONTINUE TO OPERATE. TO AVOID THIS, TURN THE TIME/INCREMENT SWITCH ON THE PLUG-IN UNIT TO ITS SLOWEST SPEED AND SWITCH THE DESIRED ROW OUT WHILE IT IS NOT IN OPERATION.

PLUG-IN UNIT

OPERATING INSTRUCTIONS

THE FOLLOWING INFORMATION IS AN ABBREVIATED OPERATING PROCEDURE FOR EACH PLUG-IN UNIT. THE INSTRUCTIONS WILL DEMONSTRATE THE BASIC FEATURES OF EACH UNIT. FOR DETAILED OPERATING INSTRUCTIONS, SEE THE PLUG-IN UNIT SECTION OF THE MANUAL.

TYPE B PLUG-IN UNIT

INSERT THE TYPE B FIRMLY INTO THE PLUG-IN COMPARTMENT OF THE TYPE 200 AND TIGHTEN THE SECURING SCREW. TURN ON THE POWER AND ALLOW A FEW MINUTES FOR THE SYSTEM TO REACH OPERATING TEMPERATURE.

1. CONNECT A COAXIAL CABLE FROM THE MAIN OUTPUT CONNECTOR OF THE TYPE B TO THE MONITOR OSCILLOSCOPE VERTICAL INPUT. SET THE SWEEP RATE OF THE OSCILLOSCOPE TO 500 SEC/DIV.

2. CONNECT A JUMPER CABLE FROM THE TRIGGER OUT JACK OF THE TYPE B TO THE EXTERNAL TRIGGER INPUT OF THE MONITOR OSCILLOSCOPE.

3. TURN ON ALL ROW SWITCHES OF THE TYPE 200.

4. PRESET THE FRONT PANEL CONTROLS OF THE TYPE B AS FOLLOWS:

SLOPE BALANCE	MIDRANGE
TIME/INCREMENT	100μsec
TRIGGER SOURCE	INT
TRIGGER MODE	NORMAL
EXPANSION AMPLITUDE	CALIBRATED

5. YOU SHOULD OBSERVE A RANDOM WAVEFORM OF FIFTY SLOPES OR INCREMENTS, EACH WITH A DURATION OF 100 μSEC. ADJUST THE OSCILLOSCOPE TRIGGERING SO THAT THE NO. 1 INCREMENT IS AT THE START OF THE TRACE.

6. VARY THE SECONDARY MATRIX KNOBS (RED) AND NOTE THE INDIVIDUAL SLOPES AS THEY VARY. THE FOLLOWING INCREMENTS WILL CHANGE LEVEL SINCE THE FINISH POINT FOR ONE SLOPE IS THE START POINT OF THE NEXT.

7. THE PRIMARY MATRIX KNOBS (BLACK) WILL HAVE NO EFFECT ON THE DISPLAY AND SHOULD BE ALL TURNED CCW.

8. CHANGE THE TIME PER INCREMENT SWITCH AND NOTICE THE INCREMENT TIME VARIES BUT THE WAVEFORM RATIO REMAINS THE SAME.

9. TURN EXPANSION KNOB TO MAXIMUM. VARY THE PRIMARY MATRIX (RED) CONTROLS AND NOTICE THAT THE WIDTH OF THE VARIOUS INCREMENTS CHANGES FROM 100μSEC TO 2000μSEC. TOTAL TIME OF ONE PROGRAM IS THE SUM OF THE INDIVIDUAL INCREMENT TIMES.

10. SLOPE BALANCE MAY HAVE TO BE ADJUSTED FOR EACH TIMING RANGE.

PLUG-IN UNIT OPERATING INSTRUCTIONS (CONTINUED)

TYPE C PLUG-IN UNIT

INSERT THE TYPE C FIRMLY INTO THE PLUG-IN COMPARTMENT OF THE TYPE 200 AND TIGHTEN THE SECURING SCREW. TURN ON THE POWER AND ALLOW A FEW MINUTES FOR THE SYSTEM TO REACH OPERATING TEMPERATURE.

1. CONNECT A COAXIAL CABLE FROM THE MAIN OUTPUT CONNECTOR OF THE TYPE C TO A MONITOR OSCILLOSCOPE VERTICAL INPUT. SET THE SWEEP RATE OF THE MONITOR OSCILLOSCOPE TO 5 MSEC/DIV.

2. CONNECT A JUMPER CABLE FROM THE TYPE C TRIGGER OUT JACK TO THE EXTERNAL TRIGGER INPUT ON THE MONITOR OSCILLOSCOPE

3. TURN ON ALL ROW SWITCHES OF THE TYPE 200.

4. PRESET THE FRONT PANEL CONTROLS OF THE TYPE C AS FOLLOWS:

OUTPUT AMPLITUDE	MIDRANGE
TIME/INCREMENT	100 µSEC
TRIGGER SOURCE	INTERNAL
TRIGGER MODE	NORM.

5. SET THE TRIGGERING CONTROLS OF THE OSCILLOSCOPE FOR A STABLE PRESENTATION.

6. TURN ALL SECONDARY MATRIX (RED) CONTROLS FULLY COUNTERCLOCKWISE. AT THIS POINT, YOU SHOULD BE OBSERVING THE DISPLAY OF A COMPLETE 50-INCREMENT PROGRAM. EACH INCREMENT SHOULD BE 100µSEC LONG.

7. VARY THE SECONDARY MATRIX (RED) CONTROLS AND NOTICE THAT THE WIDTH OF THE VARIOUS INCREMENTS CHANGES FROM 100 µSEC TO 2000 µSEC. TOTAL TIME OF ONE PROGRAM IS THE SUM OF THE INDIVIDUAL INCREMENT TIMES.

8. VARY THE PRIMARY MATRIX (BLACK) CONTROLS AND NOTICE THAT THE AMPLITUDE OF THE VARIOUS INCREMENTS CHANGES OVER A 30-VOLT RANGE.

9. CHANGE THE SETTING OF THE TIME/INCREMENT SWITCH AND NOTICE THE CHANGE IN TIME OF THE INCREMENTS. THE INCREMENTS CHANGE IN TIME AS A GROUP, BUT THE RATIO IN TIME OF ONE INCREMENT TO ANOTHER REMAINS THE SAME.

PLUG-IN UNIT OPERATING INSTRUCTIONS (CONTINUED)

TYPE D PLUG-IN UNIT

INSERT THE TYPE D FIRMLY INTO THE PLUG-IN COMPARTMENT OF THE TYPE 200 AND TIGHTEN THE SECURING SCREW. TURN ON THE POWER AND ALLOW A FEW MINUTES FOR THE SYSTEM TO REACH OPERATING TEMPERATURE.

1. CONNECT A COAXIAL CABLE FROM THE SLOPES-PRIMARY CONNECTOR OF THE TYPE D TO A MONITOR OSCILLOSCOPE VERTICAL AMPLIFIER INPUT. SET THE SWEEP RATE OF THE MONITOR OSCILLOSCOPE TO 5 MSEC/DIV.

2. CONNECT A JUMPER CABLE FROM THE TYPE D TRIGGER OUT JACK TO THE EXTERNAL TRIGGER INPUT ON THE MONITOR OSCILLOSCOPE.

3. TURN ON ALL ROW SWITCHES OF THE TYPE 200.

4. PRESET THE FRONT PANEL CONTROLS OF THE TYPE D AS FOLLOWS:

OUTPUT AMPLITUDE	MIDRANGE
TIME/INCREMENT	100μSEC
TRIGGER SOURCE	INTERNAL
TRIGGER MODE	NORMAL

5. SET THE TRIGGERING CONTROLS OF THE OSCILLOSCOPE FOR A STABLE PRESENTATION. AT THIS POINT, YOU SHOULD BE OBSERVING ONE OF THE TWO OUTPUT PROGRAMS. THIS PROGRAM (AS DOES THE OTHER PROGRAM) SHOULD CONTAIN FIFTY INCREMENTS THAT ARE 100 μSEC LONG.

PLUG-IN UNIT OPERATING INSTRUCTIONS (CONTINUED)

TYPE E PLUG-IN UNIT

INSERT THE TYPE E FIRMLY INTO THE PLUG-IN COMPARTMENT OF THE TYPE 200 AND TIGHTEN THE SECURING SCREW. TURN ON THE POWER AND ALLOW A FEW MINUTES FOR THE SYSTEM TO REACH OPERATING TEMPERATURE.

1. CONNECT A COAXIAL CABLE FROM THE MAIN OUTPUT CONNECTOR OF THE TYPE E TO A MONITOR OSCILLOSCOPE VERTICAL INPUT. SET THE SWEEP RATE OF THE OSCILLOSCOPE TO 100 μSEC/DIV.

2. CONNECT A JUMPER CABLE FROM THE TYPE E PRIMARY AND SECONDARY TRIGGER OUT JACK TO THE EXTERNAL TRIGGER INPUT OF THE MONITOR OSCILLOSCOPE.

3. TURN ON ALL ROW SWITCHES OF THE TYPE 200.

4. PRESET THE FRONT PANEL CONTROLS OF THE TYPE E PLUG-IN AS FOLLOWS:

OUTPUT AMPLITUDE	MIDRANGE
TIME/INCREMENT	100 μSEC (VARIABLE CLOCKWISE)
TRIGGER SOURCE	INTERNAL
MATRIX MODE	PRI AND SEC.
TRIGGER MODE	NORMAL

5. TRIGGER THE OSCILLOSCOPE ON THE NO. 1 INCREMENT IN ROW "A". YOU SHOULD OBSERVE APPROXIMATELY 10 INCREMENTS OF DIFFERENT VOLTAGE LEVELS. VARY THE PRIMARY KNOBS (BLACK) OF ROW "A"; THE INCREMENT VOLTAGE LEVELS SHOULD CHANGE.

6. SET THE TIME PER INCREMENT SWITCH TO 10 μSEC, THE FULL 100 INCREMENTS SHOULD APPEAR ON THE OSCILLOSCOPE.

PLUG-IN UNIT OPERATING INSTRUCTIONS (CONTINUED)

TYPE F PLUG-IN UNIT

INSERT THE TYPE F FIRMLY INTO THE PLUG-IN COMPARTMENT OF THE TYPE 200 AND TIGHTEN THE SECURING SCREW. TURN ON THE POWER AND ALLOW A FEW MINUTES FOR THE SYSTEM TO REACH OPERATING TEMPERATURE.

1. CONNECT A COAXIAL CABLE FROM THE SLOPES ONLY CONNECTOR OF THE TYPE F TO THE MONITOR OSCILLOSCOPE VERTICAL INPUT. SET THE SWEEP RATE OF THE OSCILLOSCOPE TO 500 µSEC/DIV.

2. CONNECT A JUMPER CABLE FROM THE TRIGGER OUT JACK OF THE TYPE F TO THE EXTERNAL TRIGGER INPUT OF THE MONITOR OSCILLOSCOPE.

3. TURN ON ALL ROW SWITCHES OF THE TYPE 200.

4. PRESET THE FRONT PANEL CONTROLS OF THE TYPE F AS FOLLOWS:

OUTPUT AMPLITUDE	MIDRANGE
TIME/INCREMENT	100 µSEC
TRIGGER SOURCE	INTERNAL
TRIGGER MODE	NORMAL

5. YOU SHOULD OBSERVE A RANDOM WAVEFORM OF FIFTY SLOPES OR INCREMENTS, EACH WITH A DURATION OF 100 µSEC. ADJUST THE OSCILLOSCOPE TRIGGERING SO THAT THE NO. 1 INCREMENT IS AT THE START OF THE TRACE.

6. VARY THE SECONDARY MATRIX KNOBS (RED) AND NOTE THE INDIVIDUAL SLOPES AS THEY VARY. THE FOLLOWING INCREMENTS WILL CHANGE LEVEL SINCE THE FINISH POINT FOR ONE SLOPE IS THE START POINT OF THE NEXT.

7. THE PRIMARY MATRIX KNOBS (BLACK) WILL HAVE NO EFFECT ON THE DISPLAY AND SHOULD BE ALL TURNED CCW.

8. CHANGE THE TIME PER INCREMENT SWITCH AND NOTICE THE INCREMENT TIME VARIES BUT THE WAVEFORM RATIO REMAINS THE SAME.

PLUG-IN UNIT OPERATING INSTRUCTIONS (CONTINUED)

TYPE G PLUG-IN UNIT

INSERT THE TYPE G FIRMLY INTO THE PLUG-IN COMPARTMENT OF THE TYPE 200 AND TIGHTEN THE SECURING SCREW. TURN ON THE POWER AND ALLOW A FEW MINUTES FOR THE SYSTEM TO REACH OPERATING TEMPERATURE.

1. CONNECT A COAXIAL CABLE FROM THE + MAIN OUTPUT CONNECTOR OF THE TYPE G TO THE MONITOR OSCILLOSCOPE VERTICAL INPUT. SET THE SWEEP RATE OF THE OSCILLOSCOPE TO 500μSEC/DIV.

2. CONNECT A JUMPER CABLE FROM THE MULTI ROW JACK OF THE TYPE G TO THE EXTERNAL TRIGGER INPUT OF THE MONITOR OSCILLOSCOPE.

3. TURN ON ALL ROW SWITCHES OF THE TYPE 200.

4. PRESET THE FRONT PANEL CONTROLS OF THE TYPE G AS FOLLOWS:

CLAMP ADJ.	MIDRANGE
OUTPUT AMPLITUDE	MIDRANGE
TIME/INCREMENT	100μSEC
TRIGGER MODE	INTERNAL
MAIN OUTPUT	NORMAL

5. YOU SHOULD OBSERVE A RANDOM WAVEFORM OF 50 SLOPES OR INCREMENTS, EACH WITH A DURATION OF 100μSEC. ADJUST THE OSCILLOSCOPE TRIGGERING SO THAT THE NO. 1 INCREMENT IS AT THE START OF THE TRACE.

6. VARY THE SECONDARY MATRIX KNOBS (RED) AND NOTE THE INDIVIDUAL SLOPES VARY. THE FOLLOWING INCREMENTS WILL CHANGE LEVEL SINCE THE FINISH POINT FOR ONE SLOPE IS THE START POINT OF THE NEXT.

7. THE PRIMARY MATRIX KNOBS (BLACK) WILL HAVE NO EFFECT ON THE DISPLAY AND SHOULD BE ALL TURNED CCW.

8. CHANGE THE TIME PER INCREMENT SWITCH AND NOTICE THE INCREMENT TIME VARIES BUT THE WAVEFORM RATIO REMAINS THE SAME.

9. TURN MAIN OUTPUT TO CLAMP. INCREMENT NO. 1 MAY NOW BE ADJUSTED TO THE DESIRED DC LEVEL WITH THE CLAMP ADJ. INCREMENT NO. 2 WILL NOW BE THE BEGINNING SLOPE OF THE WAVEFORM.

SECTION 3

CIRCUIT DESCRIPTION

GENERAL INFORMATION

THE TYPE 200 CONTAINS FOUR MAIN CIRCUITS: POWER SUPPLY, VERTICAL RING COUNTER, HORIZONTAL RING COUNTER AND THE TWO MATRIX NETWORKS.

THE VERTICAL RING COUNTER HAS FIVE SECTIONS, ONE FOR EACH HORIZONTAL MATRIX ROW. THE VERTICAL COUNTER SWITCHES TO THE NEXT ROW ON RECEIPT OF A TRIGGER SIGNAL FROM THE HORIZONTAL COUNTER. IF A GIVEN ROW SWITCH IS TURNED OFF, THE COUNTER SKIPS THAT ROW AND AUTOMATICALLY SWITCHES TO THE NEXT ON ROW.

THE HORIZONTAL RING COUNTER HAS TEN SECTIONS, ONE FOR EACH VERTICAL MATRIX ROW. THE HORIZONTAL COUNTER SWITCHES ON IMPULSE FROM THE PLUG-IN UNIT.

THERE ARE TWO SEPARATE MATRIX NETWORKS, PRIMARY AND SECONDARY. BOTH ARE CONVENTIONAL DIODE MATRIX CIRCUITS. A GIVEN INCREMENT IS SELECTED BY FORWARD BIASING A GIVEN MATRIX DIODE WITH A COMBINATION OF THE TWO COUNTER CIRCUITS. EACH DIODE IS CONNECTED TO A POTENTIOMETER. WHEN THE PARTICULAR DIODE IS FORWARD BIASED, THE VOLTAGE SET BY THE POTENTIOMETER APPEARS AT THE OUTPUT OF THE MATRIX. THIS VOLTAGE CORRESPONDS TO THE VOLTAGE OF ONE OF THE INCREMENTS IN THE COMPLETE PROGRAM.

POWER SUPPLY

THE POWER SUPPLY OF THE TYPE 200 FURNISHES REGULATED VOLTAGES TO ALL THE CIRCUITS, EXCEPT FILAMENTS, IN THE TYPE 200 AND THE PLUG-IN UNIT.

THE POWER SUPPLY PROVIDES SERIES REGULATED VOLTAGES OF -210, -60, (TO THE MATRIX NETWORKS ONLY), +100 AND +250 VOLTS. ALL SUPPLIES ARE REFERENCED TO THE -210-VOLT SUPPLY WHICH IS, IN TURN, REFERENCED TO VOLTAGE REGULATOR TUBE V104.

THE -210-VOLT SUPPLY OPERATES AS FOLLOWS: ONE SIDE OF THE OUTPUT OF THE BRIDGE RECTIFIER (D109, D110, D111 AND D112) IS CONNECTED TO THE PLATES OF V101. THE CATHODES OF V101 ARE TIED TO GROUND. THE OTHER OUTPUT SIDE OF THE BRIDGE RECTIFIER IS CONNECTED TO THE LOAD. ALL CURRENT THROUGH THE LOAD MUST PASS THROUGH V101. V101 REGULATES THE VOLTAGE ACROSS THE LOAD BY CONTROLLING THE AMOUNT OF CURRENT THROUGH THE LOAD.

V101 IS CONTROLLED BY V102, V103 AND V104. THE ACTION OF THESE TUBES IS SUCH THAT IF THE VOLTAGE ACROSS THE LOAD ATTEMPTS TO INCREASE, A MORE NEGATIVE BIAS WILL BE PLACED ON THE GRID OF V101. WITH MORE NEGATIVE BIAS, V101 DROPS MORE VOLTAGE AND CAUSES A CORRECTIVE DECREASE OF THE VOLTAGE ACROSS THE LOAD. IF THE VOLTAGE ACROSS THE LOAD DECREASES, THE BIAS ON V101 DECREASES, LESS VOLTAGE IS DROPPED BY C101, AND THE VOLTAGE ACROSS THE LOAD MAKES A CORRECTIVE INCREASE.

REGULATION OF THE +100 AND +250 VOLT SUPPLIES IS VERY SIMILAR. IN THE +100 VOLT SUPPLY, V107A IS THE SERIES REGULATOR TUBE AND V106 IS THE CONTROL TUBE.

CIRCUIT DESCRIPTION (CONTINUED)

VERTICAL COUNTER

THE VERTICAL COUNTER IS A FIVE-SECTION RING COUNTER THAT "ENABLES" THE HORIZONTAL ROWS OF THE PRIMARY AND SECONDARY MATRIX NETWORKS.

WHEN THE INSTRUMENT IS TURNED ON, ONLY ONE ROW OF THE FIVE TRIGGER TUBES (V303, V306, V309, V312 OR V316) WILL TURN ON. THIS CAUSES ONE OF THE MULTIVIBRATORS (V302, V305, V308, V311 OR V315) TO CHANGE STATE WHICH, IN TURN, DRIVES ONE OF THE MATRIX "ENABLE" TUBES (V301, V304, V307, V310 OR V314) INTO CONDUCTION. FOR EXAMPLE, CONSIDER THE CIRCUIT OF V301 WHEN IT IS TURNED ON. ITS GRID VOLTAGE IS REDUCED TO GROUND WHEN MULTIVIBRATOR V302 CHANGES STATE. THIS PLACES THE CATHODE OF V301 NEAR GROUND AND NEON LAMP B301 TURNS ON. IN ADDITION, ONE SIDE OF EACH ROW "A" MATRIX (PRIMARY AND SECONDARY) IS BROUGHT NEAR GROUND AND DIODES D201 THROUGH D210 ARE FORWARD BIASED AND THE VOLTAGE SET BY EACH CONTROL IS APPLIED TO A CATHODE FOLLOWER GRID. THUS, THE ENTIRE ROW IN BOTH THE PRIMARY AND SECONDARY MATRIX NETWORKS HAS BEEN "ENABLED." THE HORIZONTAL COUNTER THEN ENABLES THE INDIVIDUAL TUBES IN THE ROW IN A 1 THROUGH 10 SEQUENCE. AT THE END OF THE HORIZONTAL COUNTER SCAN, A TRIGGER PULSE SHIFTS THE VERTICAL COUNTER TO THE NEXT HORIZONTAL ROW.

IF ONE OF THE ROW SWITCHES IS TURNED OFF, THE VERTICAL COUNTER WILL SKIP AHEAD TO THE NEXT ROW THAT IS TURNED ON.

HORIZONTAL COUNTER

THIS IS A TEN-SECTION RING COUNTER SIMILAR TO THE VERTICAL COUNTER. THE TRIGGER PULSES THAT DRIVE THE COUNTER ARE OBTAINED FROM THE PLUG-IN UNIT. AS EACH MULTIVIBRATOR IN THE HORIZONTAL COUNTER IS SWITCHED, IT "GATES ON" AMPLIFIERS IN THE OUTPUTS OF BOTH THE PRIMARY AND SECONDARY MATRIX NETWORKS. AS EACH AMPLIFIER IS GATED ON, THE VOLTAGE LEVEL SET BY THE MATRIX CONTROLS IS AMPLIFIED AND THEN COUPLED TO A COMMON-OUTPUT CATHODE FOLLOWER (V105A-B). THIS OUTPUT IS CONNECTED DIRECTLY TO THE PLUG-IN UNIT.

MATRIX NETWORKS

EACH OF THE TWO MATRIX NETWORKS CONSISTS OF FIFTY CONTROLS, TEN CATHODE FOLLOWERS AND TEN GATED AMPLIFIERS. THE GRID OF EACH CATHODE-FOLLOWER IS CONNECTED TO FIVE DIODES. ONLY ONE OF THESE DIODES WILL BE FORWARD BIASED WHILE ALL OTHERS ARE BACK BIASED. SINCE THE DIODES ARE CONNECTED TO THE WIPERS OF THE MATRIX CONTROLS, THE VOLTAGE APPLIED TO THE CATHODE FOLLOWER GRID DEPENDS ON THE SETTING OF THE CONTROL.

FROM THE CATHODE FOLLOWER, THIS SIGNAL VOLTAGE PASSES DIRECTLY TO THE SUPPRESSOR GRID OF THE GATED AMPLIFIERS AND ON TO THE OUTPUT CATHODE FOLLOWER.

SECTION 4

CALIBRATION AND MAINTENANCE

GENERAL INFORMATION

THIS SECTION INCLUDES THE CALIBRATION PROCEDURE FOR THE TYPE 200 AND A GENERAL MAINTENANCE GUIDE.

USE THIS SECTION WHENEVER THE TYPE 200 FAILS TO OPERATE OR DOES NOT MEET SPECIFICATIONS. THE FIRST PORTION OF THIS SECTION CONTAINS GENERAL MAINTENANCE INFORMATION AND THE LATTER PORTION INCLUDES CALIBRATION PLUS MORE SPECIFIC TROUBLESHOOTING DATA.

VISUAL INSPECTION

VISUAL INSPECTION SHOULD BE THE FIRST STEP IN ANY TROUBLESHOOTING TECHNIQUE. VISUAL INSPECTION INCLUDES NOT ONLY A CHECK OF CONTROL SETTINGS BUT INTERNAL ITEMS SUCH AS LOOSE OR BROKEN CONNECTIONS, BURNT COMPONENTS, BLOWN FUSES, IMPROPERLY SEATED TUBES, ETC. IF ANY BURNT COMPONENTS ARE DISCOVERED, LOOK FOR OTHER, LESS OBVIOUS, CAUSES OF TROUBLE. BURNT COMPONENTS ARE USUALLY CAUSED BY SOME OTHER FAULT IN THE CIRCUIT SUCH AS A SHORTED TUBE ELEMENT OR CAPACITOR.

TUBE CHECKS

THE BEST WAY TO CHECK A VACUUM TUBE IS BY SUBSTITUTING IT WITH ANOTHER TUBE OF THE SAME TYPE THAT IS KNOWN TO BE GOOD. AFTER A TUBE HAS BEEN CHECKED IN THIS MANNER, RETURN IT TO ITS ORIGINAL LOCATION. THIS HELPS AVOID THE NEED FOR RECALIBRATION BECAUSE OF SLIGHT DIFFERENCES BETWEEN TUBES OF THE SAME TYPE.

POWER SUPPLY VOLTAGES

A FAILURE IN ONE OF THE POWER SUPPLY VOLTAGES CAN CAUSE A WIDE VARIETY OF TROUBLE SYMPTOMS. DUE TO THIS, MAKE SURE THE POWER SUPPLIES ARE FUNCTIONING BEFORE GOING ON WITH DETAILED TROUBLESHOOTING.

CALIBRATION AND MAINTENANCE SEQUENCE

FOLLOW THE STEPS IN THIS PROCEDURE IN THE ORDER GIVEN. THE STEPS ARE ARRANGED TO AVOID UNNECESSARY REPETITION OF CALIBRATION STEPS AND TO PROVIDE A LOGICAL TROUBLESHOOTING GUIDE.

EQUIPMENT REQUIRED

THE FOLLOWING EQUIPMENT IS REQUIRED FOR A COMPLETE CALIBRATION OF THE TYPE 200:

CALIBRATION AND MAINTENANCE

EQUIPMENT REQUIRED (CONTINUED)

1. A TEST OSCILLOSCOPE WITH THE FOLLOWING SPECIFICATIONS

INPUT IMPEDANCE	AT LEAST 1 MEGOHM
HORIZONTAL SWEEP ACCURACY	3%
AN EXTERNAL TRIGGER INPUT	

2. VOLTMETER WITH A SENSITIVITY OF AT LEAST 20,000 OHMS PER VOLT AND AN ACCURACY OF AT LEAST 1%.

3. VARIABLE LINE VOLTAGE SOURCE FROM 105 TO 125 VOLTS.

1. POWER SUPPLY ADJUSTMENT AND CHECKS

-210 VOLT ADJUSTMENT

WITH THE VOLTMETER, MEASURE THE VOLTAGE OF THE -210 VOLT POWER SUPPLY. IF THE VOLTAGE DOES NOT MEASURE EXACTLY 210 VOLTS ON THE VOLTMETER, ADJUST THE -210V ADJ.

TROUBLESHOOTING NOTE

IF THERE IS NO POWER:

(1) CHECK THERMAL CUTOUT AND FUSE.
(2) CHECK V101 BY SUBSTITUTION.
(3) CHECK V103 BY SUBSTITUTION.
(4) CHECK V102 BY SUBSTITUTION.
(5) CHECK V104 BY SUBSTITUTION.
(6) CHECK LINE VOLTAGE (105 TO 125 VOLTS)
(7) CHECK RESISTANCE OF R131 AND R133.
(8) CHECK DIODES D109 THROUGH D112 FOR OPEN OR SHORT.
(9) CHECK C104 FOR SHORT OR OPEN.
(10) CHECK LOAD RESISTANCE.

POWER SUPPLY VOLTAGE CHECK

WITH THE VOLTMETER, CHECK THE VOLTAGE ON THE +100, +250 AND THE -55 VOLT SUPPLIES; VOLTAGE SHOULD MEASURE ±3% ON EACH SUPPLY.

TROUBLESHOOTING NOTE

IF THE +100 VOLT SUPPLY IS NOT CORRECT:

(1) CHECK V106 AND V107.
(2) CHECK RESISTANCE OF R115 AND R116.
(3) CHECK DIODES D105 THROUGH D108 FOR OPEN OR SHORT.
(4) CHECK C102 FOR SHORT OR OPEN.
(5) CHECK LOAD RESISTANCE.

IF THE +250 VOLT SUPPLY IS NOT CORRECT:

CALIBRATION AND MAINTENANCE

POWER SUPPLY VOLTAGE CHECK

TROUBLESHOOTING NOTE (CONTINUED)

IF THE +250 VOLT SUPPLY IS NOT CORRECT:

(1) CHECK V107 AND V108.
(2) CHECK RESISTANCE OF R106, R107 AND R142.
(3) CHECK DIODES D101 THROUGH D104 FOR OPEN OR SHORT
(4) CHECK C101 FOR SHORT OR OPEN.
(5) CHECK LOAD RESISTANCE.

IF THE -55 VOLT SOURCE IS NOT CORRECT:

(1) CHECK V313.
(2) CHECK R378
(3) CHECK C316

POWER SUPPLY RIPPLE CHECK

WITH THE OSCILLOSCOPE (OR SENSITIVE PEAK-TO-PEAK, AC VOLTMETER), MEASURE THE PEAK-TO-PEAK RIPPLE VOLTAGE ON THE -210, +100 AND THE +250 VOLT SUPPLIES. MAXIMUM RIPPLE ON THE -210 VOLT SUPPLY IS 10 MILLIVOLTS; MAXIMUM RIPPLE ON THE OTHER SUPPLIES IS 15 MILLIVOLTS

TROUBLESHOOTING NOTE

USE THE SAME TROUBLESHOOTING INFORMATION AS GIVEN FOR THE "POWER SUPPLY VOLTAGE CHECK."

POWER SUPPLY REGULATION CHECK

VARY THE LINE VOLTAGE FROM 105 TO 125 VOLTS AND CHECK ALL POWER SUPPLY VOLTAGES. ALL VOLTAGES SHOULD REMAIN WITHIN ±3%.

TROUBLESHOOTING NOTE

USE THE SAME TROUBLESHOOTING INFORMATION AS GIVEN FOR THE "POWER SUPPLY VOLTAGE CHECK."

2. DECADE TRIGGER ADJUSTMENT AND CHECKS

UNIT SWITCHING CHECK

CONNECT THE TEST OSCILLOSCOPE AS FOLLOWS:

EXTERNALLY TRIGGERED FROM SYNC OUT OF PLUG-IN UNIT. CONNECT PROBE OF TEST SCOPE TO THE COMMON CATHODE CIRCUIT OF V205, V210, ETC.

CALIBRATION AND MAINTENANCE

DECADE TRIGGER ADJUST - UNIT SWITCHING CHECK (CONTINUED)

SET THE PLUG-IN UNIT FOR NORMAL, INTERNAL OPERATION. CHECK FOR THE PRESENCE OF TRIGGER PULSES AS VIEWED ON THE TEST OSCILLOSCOPE. THE TRIGGER PULSES SHOULD BE ABOUT 10 TO 30V P-P WITH AN AVERAGE DC LEVEL OF APPROXIMATELY -100V ±5V AND AT THE RATE SET BY THE PLUG-IN. CHECK THE NEON ROW INDICATORS OF THE TYPE 200 FOR SEQUENTIAL OPERATION.

TROUBLESHOOTING NOTE

IF NO TRIGGER PULSES ARE OBSERVED:

(1) MAKE SURE THE PLUG-IN UNIT IS OPERATING; TRY ADJUSTING THE UNIT TRIG ADJ. OF THE PLUG-IN OR TRY ANOTHER PLUG-IN UNIT.

IF THE NEON INDICATORS FAIL TO SHOW CONTINUOUS OR SEQUENTIAL OPERATION:

(1) CHECK V205, V210, V215, ETC., BY SUBSITUTION.

(2) CHECK V104, V209, V214, ETC., BY SUBSTITUTION.

(3) REMOVE READOUT TUBES, V202, V203, V207, V208, ETC., ONE AT A TIME, IN AN EFFORT TO ISOLATE THE FAULTY TUBE.

ADJUSTMENT OF DECADE TRIGGER

MAKE SURE ALL ROW SWITCHES OF THE TYPE 200 ARE ON. CONNECT THE TEST OSCILLOSCOPE AS FOLLOWS:

EXTERNALLY TRIGGER THE TEST OSCILLOSCOPE FROM THE SYNC OUT OF THE PLUG-IN UNIT. CONNECT THE PROBE OF THE TEST OSCILLOSCOPE TO THE PRIMARY MATRIX OUTPUT OF THE PLUG-IN UNIT OR AT THE CATHODE OF $V105^{A}$ IN THE TYPE 200.

SET THE DECADE TRIG ADJ* FOR CONTINUOUS TRIGGERING PULSES ON THE TEST OSCILLOSCOPE WHILE THE TIME/INCREMENT SWITCH OF THE PLUG-IN UNIT IS VARIED THROUGHOUT ITS RANGE.

TROUBLESHOOTING NOTE

IF THE TRIGGERING PULSES ARE NOT CONTINUOUS OR OTHERWISE IMPROPER:

(1) MAKE SURE THE UNIT TRIG ADJ IN THE PLUG-IN UNIT IS SET PROPERLY.

(2) CHECK FOR A BAD ROW SWITCH.

*ON SOME TYPE 200 INSTRUMENTS THIS ADJUSTMENT MAY BE LABELED VERT TRIG.

CALIBRATION AND MAINTENANCE

DECADE TRIGGER ADJUST - UNIT SWITCHING CHECK

TROUBLESHOOTING NOTE (CONTINUED)

(3) CHECK FOR THE PRESENCE OF A 5-VOLT PULSE AT THE GRID OF V317B.

(4) CHECK V317B BY SUBSTITUTION.

(5) CHECK V303, V306, ETC., BY SUBSTITUTION.

(6) CHECK V302, V305, ETC., BY SUBSTITUTION.

(7) CHECK T201 AND D2100 FOR SHORT AND OPEN.

LINE VOLTAGE vs TRIGGERING

LEAVE THE TEST OSCILLOSCOPE CONNECTED THE SAME WAY AS THE PREVIOUS ADJUSTMENT. VARY THE LINE VOLTAGE FROM 105 TO 125 VOLTS AND INSURE THAT CONTINUOUS TRIGGERING IS MAINTAINED.

TROUBLESHOOTING NOTE

USE THE SAME TROUBLESHOOTING INFORMATION AS GIVEN FOR THE PREVIOUS ADJUSTMENT.

3. PRIMARY AND SECONDARY MATRIX READOUT

CONNECT TEST OSCILLOSCOPE AS FOLLOWS:

EXTERNALLY TRIGGER THE TEST OSCILLOSCOPE FROM THE PLUG-IN UNIT. SYNC OUT. CONNECT THE PROBE OF THE TEST OSCILLOSCOPE TO THE PRIMARY MATRIX OUTPUT OF THE PLUG-IN UNIT. SET THE SWEEP RATE OF THE OSCILLOSCOPE SO THAT SEVERAL INCREMENTS ARE VIEWED.

PRIMARY MATRIX COMP. ADJUSTMENT

ADJUST THE PRIMARY MATRIX COMP. (C201) FOR THE SQUAREST AND FLATTEST TOPPED INCREMENTS. IT MAY BE NECESSARY TO TURN SOME OF THE PRIMARY CONTROLS OF THE TYPE 200 TO BETTER DEFINE THE INDIVIDUAL INCREMENTS.

TROUBLESHOOTING NOTE

IF THIS ADJUSTMENT CANNOT BE ACCOMPLISHED:

(1) CHECK V105 BY SUBSTITUTION.

(2) CHECK C201.

MAINTAIN THE SAME TEST OSCILLOSCOPE CONNECTIONS FOR THE NEXT ADJUSTMENT.

CALIBRATION AND MAINTENANCE

PRIMARY AND SECONDARY MATRIX READOUT (CONTINUED)

PRIMARY MATRIX H.F. ADJ.

On the plug-in unit, set the TIME/INCREMENT switch to 10μsec. Turn all primary matrix controls of the Type 200 fully counterclockwise except one. Set the controls of the test oscilloscope to display the one increment. Adjust the primary matrix H.F. ADJ (L201) for the sharpest leading corner of the displayed pulse without overshoot.

TROUBLESHOOTING NOTE

If this adjustment cannot be accomplished:

(1) Check V105 by substitution

(2) Check L201

SECONDARY MATRIX COMP. ADJUSTMENT

Connect the test oscilloscope as follows:

Externally trigger the test oscilloscope from the SYNC OUTPUT of the plug-in unit. Connect the probe of the test oscilloscope to the SECONDARY MATRIX OUTPUT of the plug-in unit.

Adjust the secondary MATRIX COMP (C201s) for the squarest and flattest topped increments. It may be necessary to turn some of the secondary matrix controls of the Type 200 to better define the individual increments.

TROUBLESHOOTING NOTE

If this adjustment cannot be accomplished:

(1) Check V105 by substitution

(2) Check C201s.

Maintain the same test oscilloscope connections for the next adjustment.

SECONDARY MATRIX H.F. ADJ.

On the plug-in unit, set the TIME/INCREMENT switch to 10μsec. Turn all secondary matrix controls of the Type 200 fully counterclockwise except one. Set the controls of the test oscilloscope to display the one increment. Adjust the secondary matrix H.F. ADJ (L201s) for the sharpest leading corner of the displayed pulse without overshoot.

CALIBRATION AND MAINTENANCE

PRIMARY AND SECONDARY MATRIX READOUT

SECONDARY MATRIX H.F. ADJ (CONTINUED)

TROUBLESHOOTING NOTE

IF THIS ADJUSTMENT CANNOT BE ACCOMPLISHED:

(1) CHECK V105 BY SUBSTITUTION.

(2) CHECK L201s.

MAINTAIN THE SAME TEST OSCILLOSCOPE CONNECTIONS FOR THE NEXT ADJUSTMEN

4. READOUT LEVEL AND COMPENSATION ADJUSTMENT

ON THE TYPE 200, SET THE FIRST TEN (TOP ROW) PRIMARY AND SECONDARY MATRIX LEVEL CONTROLS TO MIDRANGE. ON THE PLUG-IN UNIT, SET THE TIME/INCREMENT SWITCH TO 10μsec.

READOUT LEVEL ADJ.

SET THE READOUT LEVEL ADJ (R2154) FOR THE BEST COMPROMISE OF SMALLES POSITIVE AND NEGATIVE SPIKES AS SHOWN ON THE TEST OSCILLOSCOPE. (+150V ±5V).

SECONDARY READOUT COMP. ADJUSTMENT

SET EACH SECONDARY READOUT COMP. ADJUSTMENT (C2011 THROUGH C2020) FOR THE BEST COMPROMISE OF SMALLEST SPIKES ON THE INDIVIDUAL SWITCHING INCREMENTS.

TROUBLESHOOTING NOTE

IF THIS ADJUSTMENT CANNOT BE ACCOMPLISHED:

(1) CHECK THE TRIMMER.

(2) CHECK THE CORRESPONDING READOUT TUBE (I.E. V203, V208, ETC.) BY SUBSTITUTION.

CONNECT THE PROBE OF THE TEST OSCILLOSCOPE TO THE PRIMARY MATRIX OUTPUT OF THE PLUG-IN UNIT FOR THE NEXT ADJUSTMENT

PRIMARY READOUT COMP. ADJUSTMENT

SET EACH PRIMARY READOUT COMP. ADJUSTMENT (C2001 THROUGH C2010) FOR THE BEST COMPROMISE OF SMALLEST SPIKES ON THE INDIVIDUAL SWITCHING INCREMENTS.

CALIBRATION AND MAINTENANCE

READOUT LEVEL & COMP ADJ - PRIMARY READOUT (CONTINUED)

TROUBLESHOOTING NOTE

IF THIS ADJUSTMENT CANNOT BE ACCOMPLISHED:

(1) CHECK THE TRIMMER.

(2) CHECK THE CORRESPONDING READOUT TUBE. (I.E. V202, V207, ETC.) BY SUBSTITUTION.

MAINTAIN THE SAME TEST OSCILLOSCOPE CONNECTIONS FOR THE NEXT ADJUSTMENT.

5. MATRIX OPERATION CHECK

VOLTAGE RANGE OF PRIMARY AND SECONDARY INCREMENTS

VARY EACH PRIMARY MATRIX LEVEL CONTROL ON THE TYPE 200 TO INSURE THAT EACH INCREMENT HAS A 10-VOLT RANGE.

CONNECT THE PROBE OF THE TEST OSCILLOSCOPE TO THE SECONDARY MATRIX OUTPUT OF THE PLUG-IN UNIT. VARY EACH SECONDARY MATRIX LEVEL CONTR OF THE TYPE 200 TO INSURE THAT EACH INCREMENT HAS A 10-VOLT RANGE.

TROUBLESHOOTING NOTE

IF THE SAME INCREMENT IN EACH HORIZONTAL ROW DOES NOT HAVE THE PROPER RANGE OR INTERACTS WITH ADJACENT INCREMENTS, CHECK THE CORRESPONDING READOUT TUBE (I.E. V202, V203, ETC.) BY SUBSTITUTION. IF ONE OR MORE UNRELATED INCREMENTS DO NOT HAVE THE PROPER VOLTAGE RANGE, LOOK FOR A BAD MATRIX DIODE (I.E. D201, D201s, D202, D202s, ETC.) OR A BAD MATRIX LEVEL POT.

CHECK NEON ROW INDICATORS

SET THE TIME/INCREMENT SWITCH OF THE PLUG-IN UNIT TO 100MSEC AND INSURE THAT ALL NEON INDICATORS ARE LIGHTING SEQUENTIALLY.

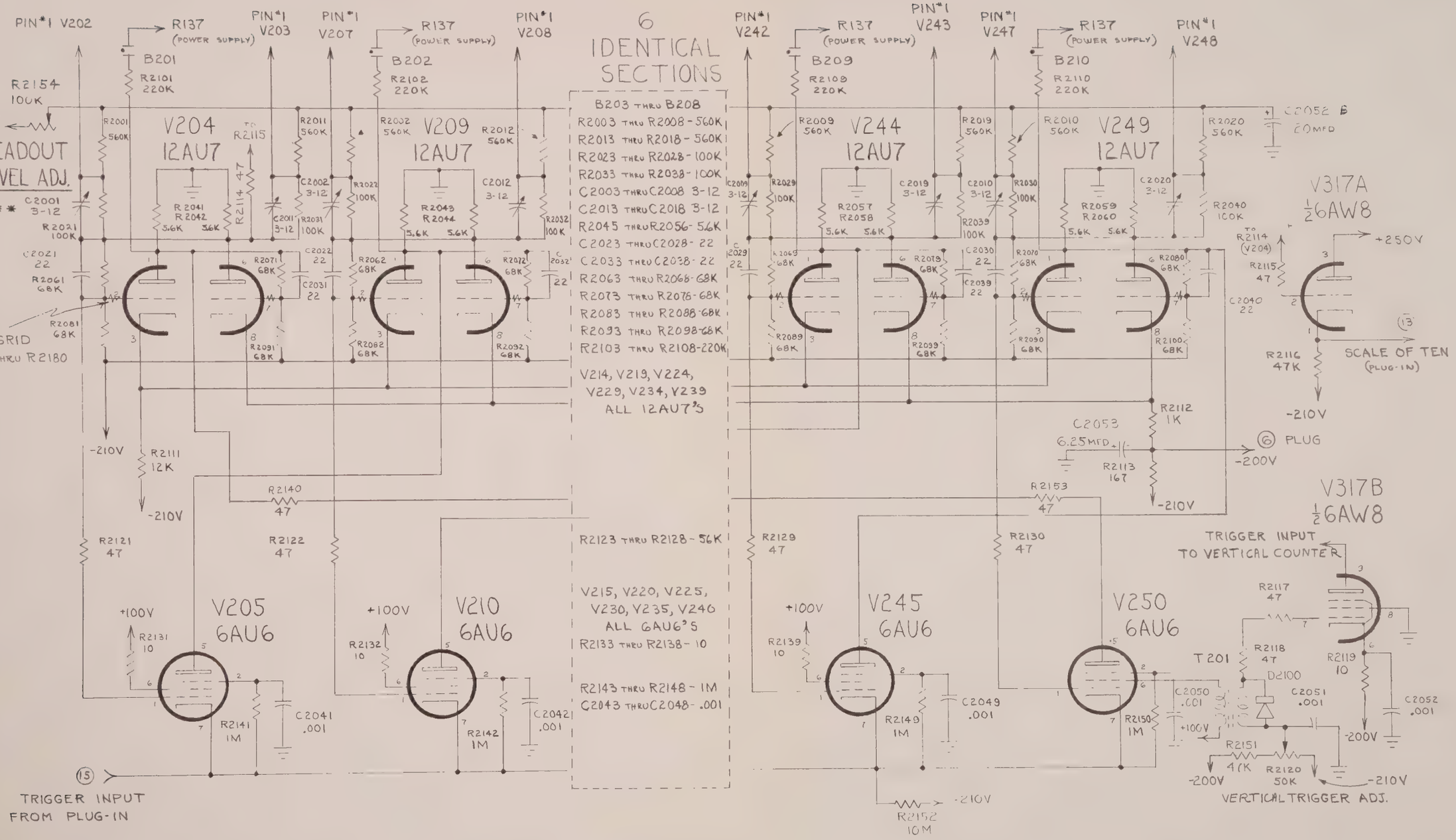
TROUBLESHOOTING NOTE

IF THE BULBS DO NOT LIGHT PROPERLY:

(1) CHECK THE BULB SUPPLY VOLTAGE.

(2) REPLACE THE BULB.

HORIZONTAL COUNTER

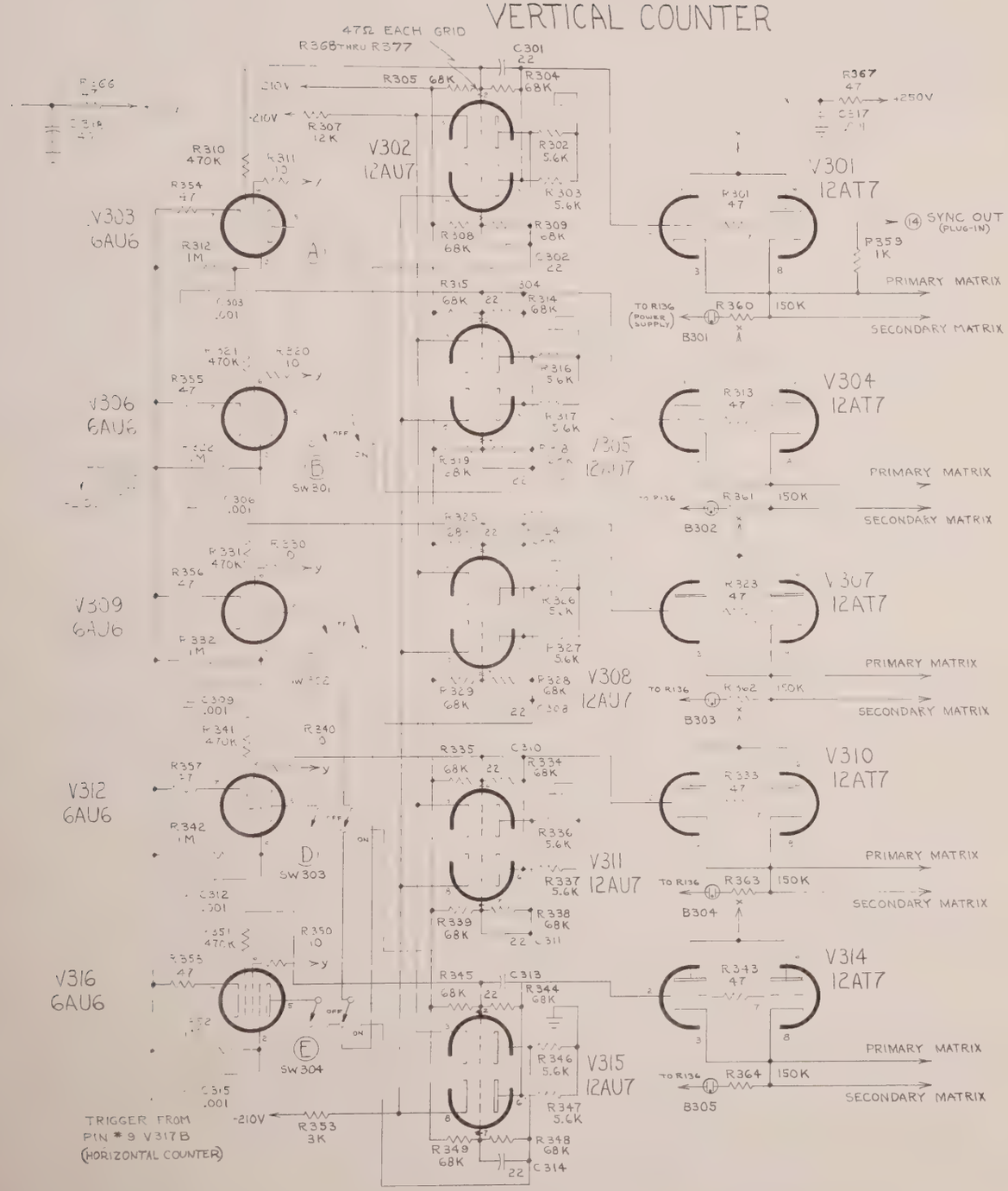


** C2001 THRU C2010 ARE PRIMARY READOUT COMP.

* C2011 THRU C2020 ARE SECONDARY READOUT COMP.

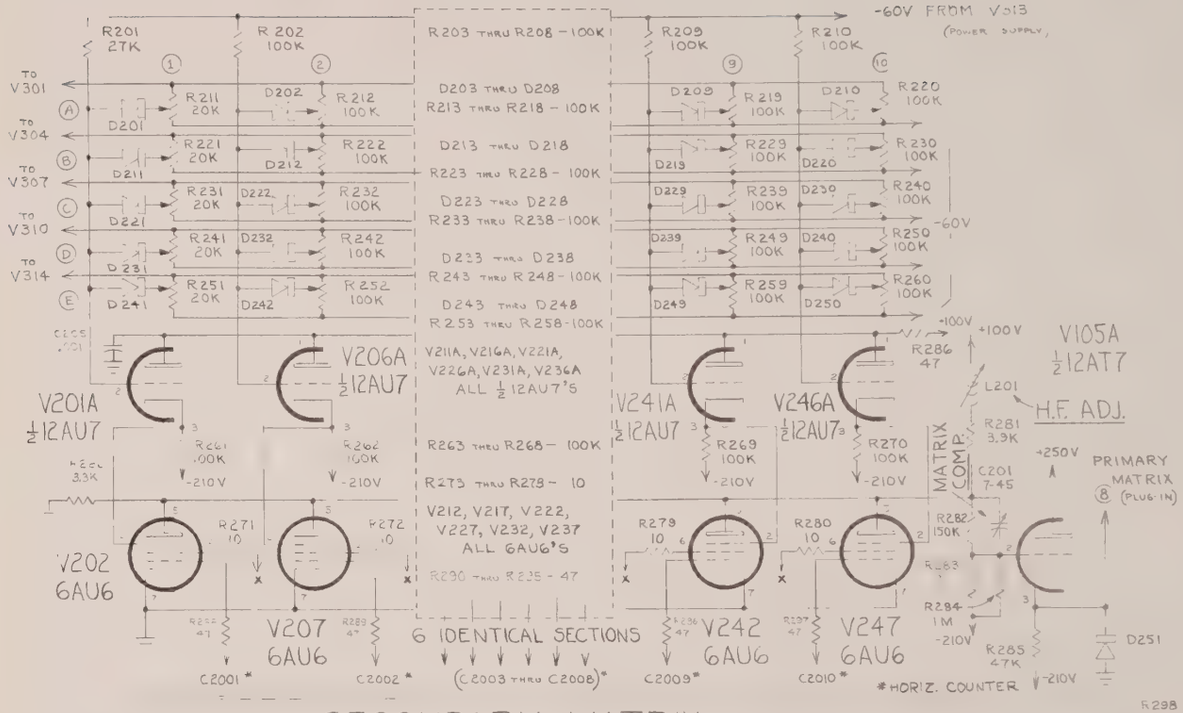
TYPE 200 WAVEFORM SYNTHESIZER 8-2-62 FAT TJP

VERTICAL COUNTER

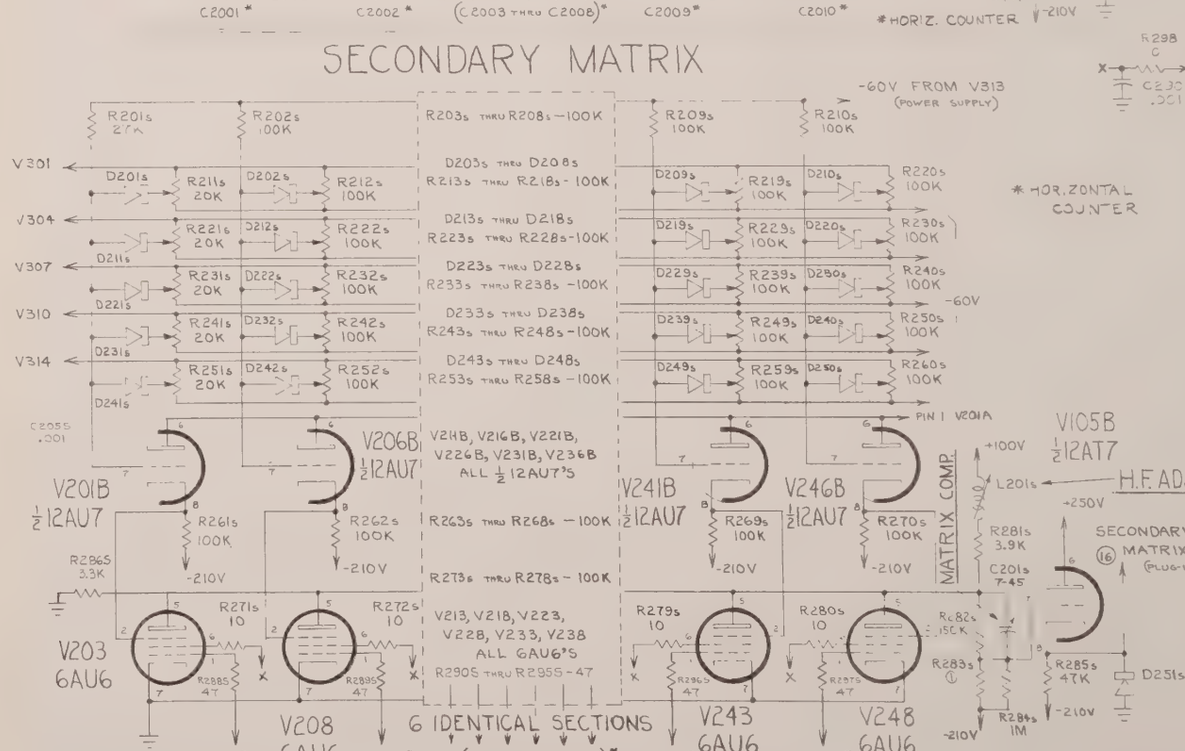


TYPE 200 WAVEFORM SYNTHESIZER 3-2-62 FAT

PRIMARY MATRIX



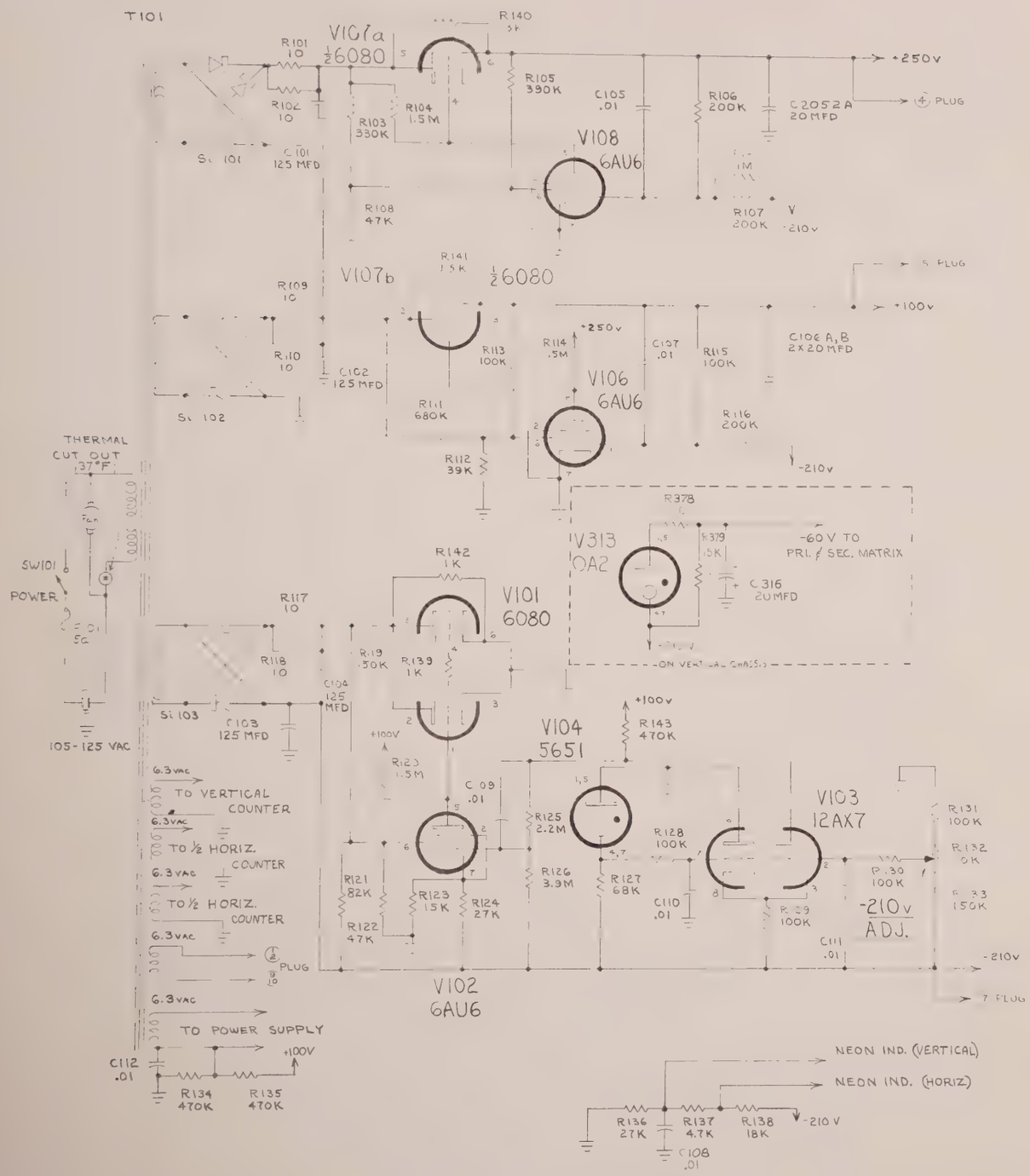
SECONDARY MATRIX



① SELECTED VALUE

TYPE 200 WAVEFORM SYNTHESIZER 3-2-62 FAT

POWER SUPPLY



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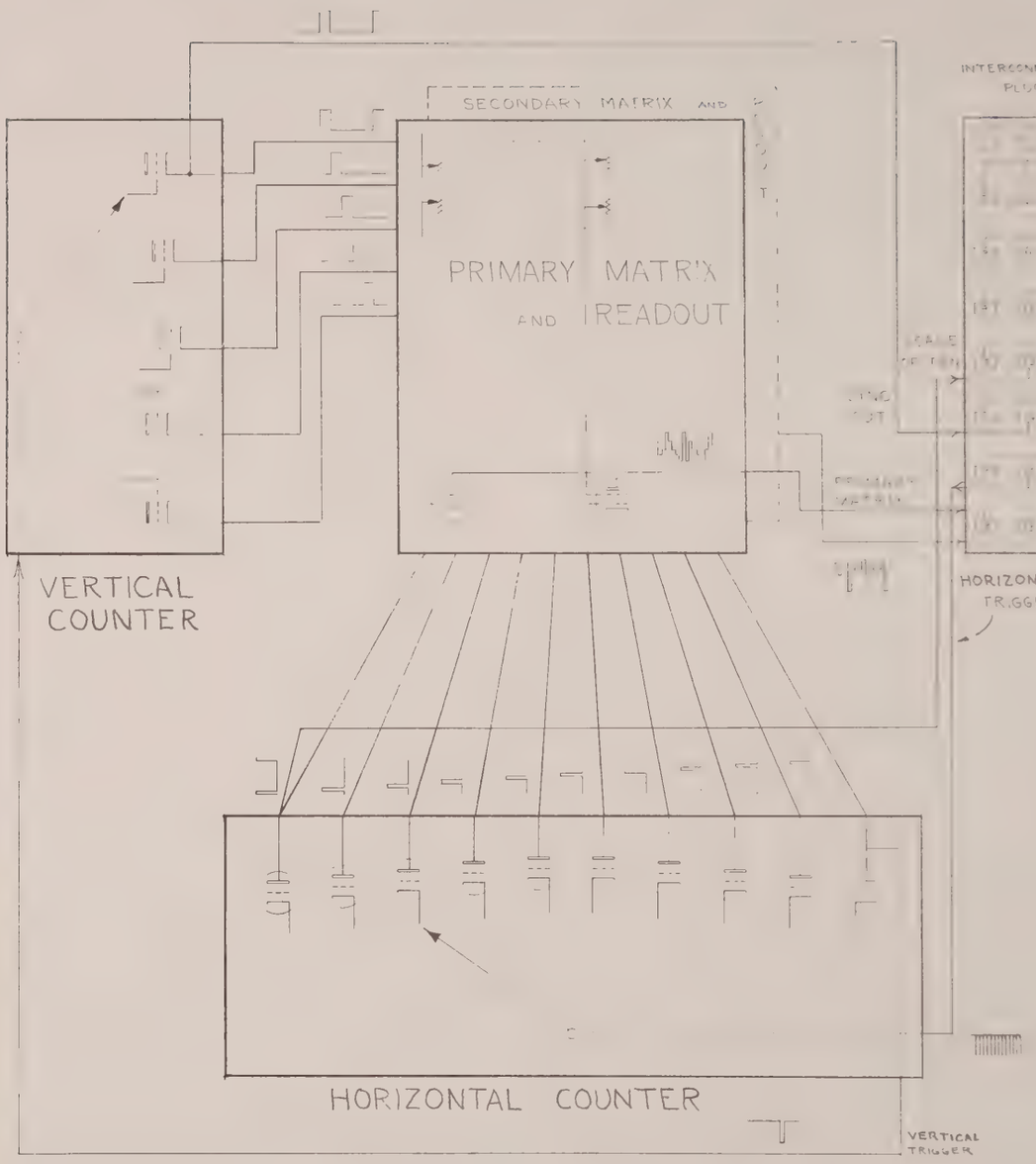


BLOCK DIAGRAM

TYPE 200 WAVEFORM SYNTHESIZER 3-2-62 FAT

OPERATING PROCEDURE

I GENERAL

A. BASIC OPERATION

1. Turn rows C, D, & E OFF in Type 200
2. Turn all Secondary Matrix (red) knobs CCW in rows A & B.
3. Set TIME/INCREMENT to 100μsec
4. Connect MONITOR or MAIN OUTPUT to scope input
5. Connect SYNC OUT to external trigger input of scope
6. Set TRIGGER SOURCE to INT.
7. Set TRIGGER MODE to NORMAL.

You should be observing twenty various voltage levels or increments each having a duration of 100μsec. Adjust scope triggering so that #1 increment is at the beginning of trace.

8. Vary the Secondary Matrix (red) knobs and notice the individual widths vary. The overall waveform duration will vary since it is a product of the (number of increments switched) X (width of each increment).
9. Vary the Primary Matrix (black) knobs and notice the individual amplitudes vary.
10. Switch on rows C, D, & E; you should have 50 increments.
11. Change TIME/INCREMENT switch and notice that increment widths vary as a group but the width ratio remains constant.

B. AUXILIARY OUTPUTS AND CONTROLS

1. OUTPUT AMPLITUDE control varies overall waveform amplitude without affecting ratio of individual amplitudes.
2. SYNC OUT is used to trigger monitor scope when you are switching two or more rows.
3. SCALE OF TEN is used to trigger monitor scope when only one row is on.

C. APPLY MAIN OUTPUT TO YOUR CIRCUIT, INSTRUMENT OR SYSTEM

II TIMING

A. TIME/INCREMENT Switch

This switch determines the fixed minimum rates at which the internal trigger generator can run. The actual trigger rate to the increments is controlled by the additional delay which each variable width setting adds in.

B. VARIABLE WIDTH

This is determined for each individual increment by the setting of the Secondary Matrix knobs. When all these knobs are turned to maximum CCW position, the time of each increment corresponds to the setting of the TIME/INCREMENT Switch. When any Secondary Matrix knob is turned CW the time before the next trigger or increment can be generated is extended by the amount of width or delay (up to 10 times the setting of TIME/INCREMENT) added in by that one knob. Each variable width control acts independently of any other.

III TRIGGERING

A. INTERNAL - NORMAL

The operation in this position was fairly well described in I and II. The triggering or increment generation is wholly internal at a rate determined by the TIME/INCREMENT Switch and individual variable width (Secondary Matrix) knobs. The output pulse waveform will be continuously repeating at a time or frequency equal to the product of (number of increments being switched) X (increment width).

B. EXTERNAL - NORMAL

In this position, each increment is singly triggered by each external trigger or MANUAL TRIGGER. The increment time or width will be wholly controlled by the external trigger rate AS LONG AS THE TIME/INCREMENT & VARIABLE WIDTH SETTING DOES NOT EXCEED THE TIME BETWEEN EXTERNAL TRIGGERS. For example: If the increment duration as set by the TIME/INCREMENT and variable width setting would have been less than 1msec. on any individual increment, a 500-cycle external trigger rate would produce increments durations of 2msec. However, if the external trigger rate were 10 KC, the increment duration would correspond to the combined TIME/INCREMENT - variable width time.

C. INTERNAL - TEN COUNT

In this position the individual increment width is determined as in the INTERNAL-NORMAL operation. However, any one of the rows of ten increments can be sequentially triggered by the RESET button (manual operation) or externally. The RESET button or an external trigger "unlocks" the next row of ten increments to be switched and lets them run at the rate already determined by the TIME/INCREMENT-variable width combination. The repetition rate cannot exceed the sum of the durations of the ten increments being triggered plus a short "hold-off" time between rows.

When using a monitor scope, trigger it from the SCALE OF TEN in this mode of operation.

D. INTERNAL - PROGRAM COUNT

In this position again, the individual increment width is determined by the TIME/INCREMENT - variable width settings as in INTERNAL-TEN COUNT operation. As in the INTERNAL-TEN COUNT operation, the RESET button or an external trigger unlocks a group of increments, only this time it is the whole program of 20, 30, 40 or 50 increments (depending on how many rows are turned on in the Type 200) that is unlocked. Each trigger will cause the program to start at #1 increment in row A and run sequentially through the number of rows switched ON and return to #1 increment where it will wait for the next trigger. The repetition rate cannot exceed the sum of the duration of all the increments in the full program plus a short "hold-off" time between programs.

When using a monitor scope, trigger it from the SYNC OUT in this mode of operation.

E. EXTERNAL - TEN COUNT OR PROGRAM COUNT

This mode will have very limited application. Pressing the RESET button will "arm" or make the TRIGGER INPUT ready to receive external triggers. The MANUAL TRIGGER or an external trigger can now be used to trigger the increments one at a time through a count of ten or the whole program, depending on the TRIGGER MODE setting.

CALIBRATION PROCEDURE & MAINTENANCE GUIDE

THIS IS THE CALIBRATION PROCEDURE USED AT THE FACTORY WHICH ASSURES THAT THE STATED OPERATIONAL SPECIFICATIONS CAN BE MET. WE HOPE THAT YOU WILL FIND IT USEFUL FOR RECALIBRATION AS WELL AS IN PERIODIC TROUBLE SHOOTING AND MAINTENANCE.

THE TROUBLE SHOOTING SUGGESTIONS HAVE BEEN ARRANGED IN ORDER OF PROGRESSIVE CALIBRATION. THIS IS TO ALLOW YOU TO MORE EASILY ISOLATE THE MALFUNCTION BY ITS PLACE IN THE SEQUENCE OF OPERATION. SINCE MANY LATER STEPS DEPEND ON THE PROPER PERFORMANCE OF PRIOR OPERATIONS, IT WOULD BE MOST WISE TO CHECK BACK TO THE BEGINNING ON ALL TROUBLES AND ELIMINATE THIS POSSIBILITY. FOR EXAMPLE, IF YOU HAVE INSTABILITY OF SEVERAL INCREMENTS YOU MIGHT SUSPECT THE MATRIX OR, QUITE LOGICALLY, THE TRIGGER CIRCUITS. HOWEVER, THE TROUBLE MIGHT WELL BE THE -210 VOLT POWER SUPPLY OUT OF REGULATION. ELIMINATE FUNDAMENTAL PROBLEMS (SUCH AS THE POWER CORD BEING PLUGGED IN!) BEFORE TROUBLE SHOOTING SPECIFIC AREAS.

ALL TESTS SHOULD BE MADE WITH A VOLTMETER HAVING 20,000 OHMS/VOLT AND A DEPENDABLE OSCILLOSCOPE WITH THE FOLLOWING CHARACTERISTICS.

(A) INPUT IMPEDANCE AT LEAST 1 MEGOHM
(B) HORIZONTAL SWEEP ACCURACY - 3%
(C) CAPABLE OF BEING EXTERNALLY TRIGGERED

CALIBRATION SEQUENCE

IF UNABLE TO MAKE SPECIFICATIONS

1. VISUAL CHECK
   - OBVIOUS DAMAGE
   - MISSING OR UNLIT TUBES
   - WRONG CONTROL SETTINGS
   - IMPROPER TEST EQUIPMENT

INSTALL "C" UNIT IN CHECKED TYPE 200
SET TIME/INCREMENT TO 100μSEC.
TURN ROWS C, D & E OFF IN TYPE 200
TURN SECONDARY MATRIX (RED) KNOBS CCW IN ROWS A & B OF THE TYPE 200
TRIGGER SOURCE.....INTERNAL
TRIGGER MODE.....NORMAL

2. POWER SUPPLY VOLTAGES

AT INTERCONNECTING PLUG CHECK THE FOLLOWING VOLTAGES

(A) -210
(B) -200
(C) +100
(D) +250

(A) (B) (C) (D)
RECHECK TYPE 200
CHECK INTERCONNECTING PLUG

PUT PROBE OF TEST SCOPE ON PIN 6 OF V1
(MILLER RUN UP TUBE)
TRIGGER SCOPE INTERNALLY

3. RATE GENERATOR

(A) ADJUST RATE GEN STABILITY POT R29 UNTIL STABLE SAWTOOTH APPEARS

(A) SWING MILLER DC BALANCE POT THRU ITS RANGE
RUN THE RATE TIMING POT THRU ITS RANGE
• REPLACE, ONE AT A TIME, V1 THRU V6
PULL V13

SET SCOPE TIME TO 10MSEC/DIV

(B) ADJUST RATE TIMING
ADJUST R62 FOR ONE SAWTOOTH PER 10MSEC

(B) RE-CHECK ALL SECONDARY MATRIX POTS FOR FULL CCW
CHECK V11 AND V13
CHECK SECONDARY MATRIX INPUT AT R55. SHOULD BE AT DC GROUND
CHECK TIMING SWITCH COMPONENTS

(C) ADJUST MILLER DC BALANCE ADJ. R66
SWITCH TRIGGER MODE BETWEEN LOCKOUT AND NORMAL
ADJUST POT SO THAT DC LEVEL OBSERVED IS NEARLY THE SAME IN BOTH MODES. SAWTOOTH SHOULD NOT RUN IN LOCKOUT MODE

A DUAL INPUT SCOPE SHOULD BE USED IN THE NEXT CHECK. TRIGGER SCOPE FROM SYNC OUT AND SIMULTANEOUSLY OBSERVE PIN 7 OF V7 AND PIN 6 OF V1

4. TRIGGER

(A) CHECK UNIT TRIGGER PULSE THIS SHOULD BE A NARROW POSITIVE GOING SPIKE OF 7 TO 10V AMPLITUDE. IT SHOULD EXACTLY COINCIDE WITH THE SAWTOOTH PEAK

(A) REPLACE V5 AND V6
REVERSE SECONDARY OR PRIMARY LEADS OF T1
REPLACE T1

PLACE SCOPE PROBE ON SCALE OF TEN. TRIGGER SCOPE INTERNALLY. TURN SCOPE GAIN UP UNTIL UNIT SWITCHING SPIKES ARE VISIBLE ON BASELINE.

(B) ADJUST UNIT TRIGGER ADJ.* R44 FOR OPTIMUM COUNT OF TEN (OBSERVE SPIKES ON BASELINE)

(B) RE-CHECK 4 (A)
REPLACE V7
RE-CHECK TYPE 200
CHECK UNIT TRIGGER ADJ. POT

(C) CHECK SCALE OF TEN FOR OCCURRENCE AT BEGINNING OF EACH ROW AND OUTPUT OF APPROX. 35V

SET SCOPE INPUT TO DC AND PLACE PROBE ON MAIN OUTPUT. TURN SEVERAL PRIMARY MATRIX KNOBS ALTERNATELY CW AND CCW

5. OUTPUT

(A) ADJUST OUTPUT LEVEL R89 FOR A CENTER GROUND REFERENCE AFTER CHECKING RANGE FROM 0 TO +25V

* ON SOME PLUG-INS THIS MAY BE LABELLED "HOR TRIG"

(B) CHECK RANGE OF OUTPUT AMPLITUDE R80 POT FOR 3 TO 1 AND MAXIMUM AMPLITUDE OF AT LEAST 35 VOLTS

(C) ADJUST OUTPUT DC BALANCE R88 SO THAT VARYING OUTPUT AMPLITUDE CAUSES MINIMUM DC SHIFT

(A) (B) (C)
REPLACE V15, V14, V12
CHECK THE POTS

PLACE SCOPE PROBE ON PIN 5, V14

(D) ADJUST PRIMARY MATRIX COMP C29 FOR FLAT-TOP SQUARE WAVE

(D) CHECK TYPE 200 OUTPUT
REPLACE C29
REPLACE V12

PLACE SCOPE PROBE ON MAIN OUTPUT

(E) ADJUST OUTPUT COMP. C31 FOR FLAT-TOP SQUARE WAVE

(E) REPLACE V14
REPLACE C31

(F) ADJUST H.F. RESPONSE L1 FOR BEST RISETIME WITHOUT OVERSHOOT

(F) CHECK R83
REPLACE L1
REPLACE V14

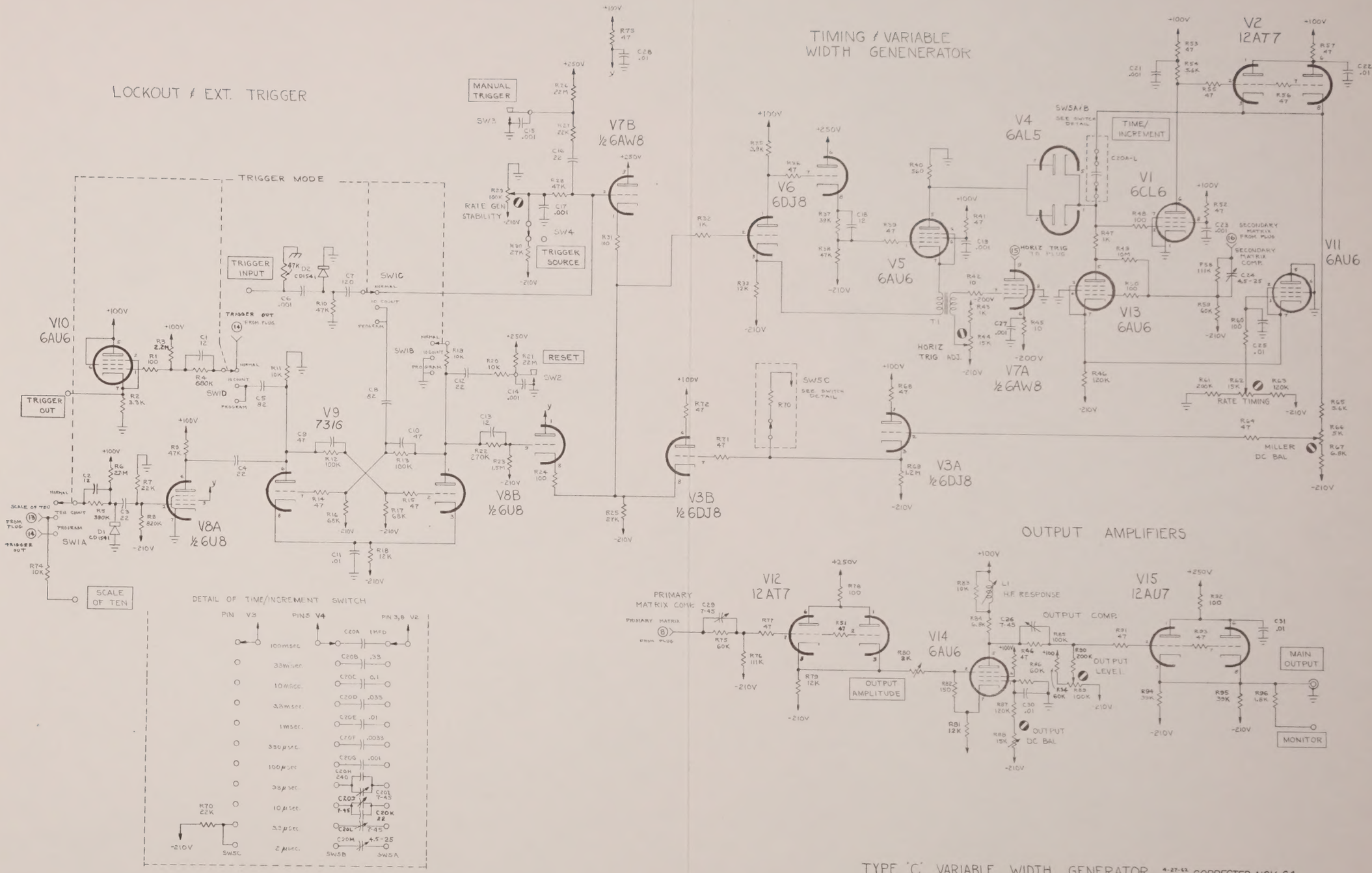
PLACE SCOPE PROBE ON PIN 7 OF V11.
TURN SEVERAL SECONDARY MATRIX KNOBS CW

(G) ADJUST SECONDARY MATRIX COMP. C24 FOR FLAT-TOP SQUARE WAVE

(G) RE-CHECK TYPE 200 OUTPUT
REPLACE C24

MONITOR MAIN OUTPUT WITH SCOPE.
TRIGGER SCOPE FROM SCALE OF TEN
SET UP "C" UNIT AS EXPLAINED UNDER INTERNAL-TEN COUNT IN OPERATING PROCEDURE
TURN ROWS C, D, E, ON IN TYPE 200

(C) ADJUST C20K FOR EXACTLY 6 INCREMENTS IN 20μSEC	
CHANGE SCOPE SPEED TO 10μSEC/DIV CHANGE TIME/INCREMENT TO 10μSEC	
(D) ADJUST C20J FOR EXACTLY 1 INCREMENT PER 10μSEC	
CHANGE TIME/INCREMENT TO 33μSEC	
(E) ADJUST C201 FOR EXACTLY 3 INCREMENTS PER 100μSEC	
(F) CHECK ALL REMAINING TIMING POSITIONS FOR ± 3% ACCURACY AND RETRIM FAST RANGES UNTIL WITHIN ± 3%	(A) THRU (F) REPLACE V13, V1 CHECK POT AND TIMING CAPACITORS
(G) CHECK VARIABLE WIDTH RATIO ON ALL RANGES FOR 10 TO L COVERAGE. USE #2 SECONDARY MATRIX KNOB IN ROW A	(G) IN THE 2μSEC. POSITION VARIABLE WIDTH RANGE MAY PROPERLY BE AS LOW AS 8 TO 1 REPLACE V13, V1 CHECK AMPLITUDE OF SECONDARY MATRIX FROM TYPE 200
9. GENERAL OUTPUTS	
(A) CHECK SYNC OUT FOR POSITIVE GOING, 15 VOLT GATE	(A) REPLACE V10
(B) CHECK OUTPUT WAVEFORM HUM FOR LESS THAN 0.1 VOLT	(B) CHANGE V15, V14
(C) CHECK INCREMENTAL TIME JITTER FOR 1 PART IN 500	(C) REPLACE V4, V1


LOCKOUT / EXT. TRIGGER
TRIGGER MODE
TRIGGER INPUT
TRIGGER OUT
SCALE OF TEN
MANUAL TRIGGER
RATE GEN STABILITY
TRIGGER SOURCE
RESET
V10 6AU6
V9 7316
V8A ½6U8
V8B ½6U8
V7B ½6AW8
V6 6DJ8
V5 6AU6
V4 6AL5
V3A ½6DJ8
V3B ½6DJ8
V1 6CL6
V7A ½6AW8
V13 6AU6
V11 6AU6
V2 12AT7
TIME/ INCREMENT
HORIZ TRIG ADJ.
RATE TIMING
MILLER DC BAL
SECONDARY MATRIX COMP.
TIMING / VARIABLE WIDTH GENENERATOR
DETAIL OF TIME/INCREMENT SWITCH
100msec
33msec
10msec
3.3msec
1msec
330μsec
100μsec
33μsec
10μsec
3.3μsec
1μsec
OUTPUT AMPLIFIERS
PRIMARY MATRIX COMP.
V12 12AT7
V14 6AU6
V15 12AU7
OUTPUT AMPLITUDE
OUTPUT COMP.
OUTPUT LEVEL
OUTPUT DC BAL
H.F. RESPONSE
MAIN OUTPUT
MONITOR
TYPE 'C' VARIABLE WIDTH GENERATOR 4-27-62 PAT CORRECTED NOV. 64